MONOGRAPH OF MALVAVISCUS[1]

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Introduction

In the plant kingdom there are certain families which are quite distinctive but with very indefinite generic bounds, the Malvaceae being one such family. For example, two species have been included in *Malvaviscus* which intergrade with *Pavonia* and which would better be placed in the latter genus. The same is true in other genera of the family as Kearney[2] found to be the case in *Sphaeralcea.* And when a taxonomist comes to consider specific and subspecific delimitation within *Malvaviscus,* he finds himself in the midst of an unmanageable and indefinable maze of incipient taxonomic entities. This can be attested to by the fact that no comprehensive work has been done in the genus since its establishment almost 200 years ago.

The situation is exemplified by the *Malvaviscus arboreus* complex where there is no constant character of taxonomic value. There is tremendous variation, even with separate branches on the same plant. In Panama, within an area of a few hundred meters, plants with 2, 3, 4, or 5 calyx lobes were found; with short or long involucre lobes; with excurrent rows of hair on the stem or without hair; etc. As a result of such manifest variation, innumerable species have been described, with descriptions based on a single specimen. If this were to be the general practice there would be almost as many species of *Malvaviscus* as there are specimens, since almost every specimen collected differs from all others at least to some slight degree. Thus in a taxonomic treatment of the genus two alternatives exist: excessive splitting into innumerable indistinct and undefinable "species," or lumping into few well-marked species with varietal classification for those groups which are distinct at their extremes but do intergrade with all or most other groups.

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[1] An investigation carried out at the Missouri Botanical Garden in the Graduate Laboratory of the Henry Shaw School of Botany of Washington University and submitted as a thesis in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

[2] Kearney, T. H., in Univ. Calif. Pub. Bot. **19:** 1–128, *pl. 1–12, 1 fig.* 1935.

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For the conscientious taxonomist there is no middle course in this genus, for if these intergrading types are to be considered as worthy of specific rank, surely the "good" or distinct species, obviously of higher degree difference even to the most casual observer, merit generic rank. It is my opinion that the second or "lumping" alternative is the only acceptable one, both from a scientific and a practical standpoint.

HISTORY OF THE GENUS

Being a showy and conspicuous plant, *Malvaviscus* has been recognized, under one name or another, for centuries. One of the first names under which this genus was included was *Alcea* of Plukenet. Sloane, Tournefort, Plumier, and others placed it in *Malva,* and Linnaeus in *Hibiscus.* Earlier, Hernandez suggested a close relationship with *Althaea,* but used the Aztec name "Atlat Zopillin" in his writing; however, Petiver in 1704 used *Althaea* in a polynomial description for a species of *Malvaviscus* (fide Dillenius).

In 1732 Dillenius proposed the name *Malvaviscus* as distinct from *Malva,* but still used it in a polynomial form as: "Malvaviscus arborescens, flore miniato clauso." He recognized that this new name was synonymous with *Alcea* (in part) of Plukenet, Petiver's "Althaea americana coccinea, flore clauso," and the Aztec "Atlat Zopillin."

Although Linnaeus in 1753 included *Malvaviscus* in *Hibiscus,* Adanson in 1763 and Cavanilles in 1787 accepted *Malvaviscus* as a valid genus in the binomial sense. But in 1788 Swartz proposed to rename the genus *Achania,* a name recognized only by a few authors of the early 19th century. In 1824 A. P. de Candolle divided *Malvaviscus* into two sections, one of which he called *Achania,* the other, *Anotea;* the latter was raised to generic rank by Kunth in 1846, but evidently it should be included in *Pavonia.* During the last century *Malvaviscus* has been generally recognized as a valid genus synonymous with the section *Achania* of de Candolle and doubtfully synonymous with de Candolle's other section, *Anotea.*

PREVIOUS WORK ON THE MALVACEAE

In the Malvaceae, as a whole, little recent taxonomic work has been done. Kearney[3] monographed the North American species

[3] loc. cit. 1935.

of *Sphaeralcea.* Roush[4] monographed *Sidalcea* and also published a synopsis of *Robinsonella.*[5] Earlier in the century Fries[6] presented a monographic treatment of *Wissadula* and *Pseudabutilon,* Hill[7] published on the acaulescent species of *Malvastrum,* and Hochreutiner[8] offered a monograph of *Anoda.* In 1907 Watt[9] published a book which included a revision of *Gossypium,* and in 1900 appeared Hochreutiner's revision of *Hibiscus.*[10]

However, previous to the turn of the century, monographic treatment of genera in the Malvaceae seems scarcely to have been attempted, although numerous non-monographic publications had appeared, some of first-rank importance. Cavanilles published on *Sida;* Garcke on *Pavonia, Abutilon, Malvastrum,* etc.; Schumann and Gürcke on Malvaceae in Martius' 'Flora Brasiliensis' and elsewhere; E. G. Baker on a synopsis of the Malveae; Bentham on a key to the Malvaceae and Sterculiaceae; Gray and Robinson on Malvaceae of North America. References to these and many other important systematic publications on the Malvaceae can be found in the 'Bradley Bibliography'[11] and in other bibliographies.

Non-taxonomic studies on Malvaceous genera have appeared rather frequently. Because of its economic importance, *Gossypium* has been the subject of many investigations, especially along cytogenetic and anatomical lines, and probably ten times as much literature has been published concerning this genus as all other genera of the Malvaceae combined. However, the bast fiber production in *Sida* and other genera, the virus transmission in *Abutilon,* photoperiodism and embryological development in several genera, and ecological studies involving certain Malvaceae have been the subjects of numerous recent investigations. Then too, chromosome counts have been made in almost all genera of the family and about 15 per cent of the species. Nor can we fail to notice the continuous use of certain species in horticultural work.

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[4] Roush, Eva M., in Ann. Mo. Bot. Gard. **18**: 117–244. 1931.

[5] Jour. Arnold Arb. **12**: 49–59, *7 figs.* 1931.

[6] Fries, R. E., in Kgl. Svenska Vet. Handl. **43**: 1–114, *10 pls.* 1908.

[7] Hill, H. W., in Jour. Linn. Soc. Bot. **39**: 216–230. 1909.

[8] Hochreutiner, B. P. G., in Ann. Cons. & Jard. Bot. Genève **20**: 29–68. 1916.

[9] Watt, G. The Wild and Cultivated Cotton Plants of the World. 406 pp. 1907.

[10] Ann. Cons. & Jard. Bot. Genève **4**: 23–191, *9 figs.* 1900.

[11] Rehder, A. The Bradley Bibliography. **2**^{2}: 518–528. Arnold Arb. Pub. 3. 1912.

MORPHOLOGY OF MALVAVISCUS

The genus *Malvaviscus* consists of woody perennial plants that may be shrub-like or vine-like, clambering or suberect. Roots are of the tap-root type, fairly thick, often twisted and distorted. Stems are terete, woody, and, although moderately stout, are unable to support the mature plant erect; they branch freely, bear many leaves, are green and generally stellate-pubescent when young, but become glabrous or subglabrous and gray-brown with age. Branches neither twine nor possess tendrils, vine-like specimens merely clambering upon available support.

The leaves are alternate, stipulate, petiolate. The blade is moderately thick, broadly ovate-cordate to linear-lanceolate, unlobed to palmatifid, deeply serrate to subentire. The pubescence of the blade varies, consisting of stellate or straight hairs or a mixture of the two on the upper surface, of more abundant stellate hairs on the lower surface; or the blade may be glabrous in age (pl. 16, figs. 2, 3, 4). Stellate hairs may be appressed to erect, few or many-rayed, large and coarse or small and fine, or a mixture of the types may occur. Venation is prominent, reticulate, usually consisting of five larger veins with numerous anastomosing lateral veinlets. The petiole is variable in length, uniformly pubescent, with a ridge of hair (often decurrent on the stem), or glabrous. Stipules are linear-lanceolate, about 7 mm. long, caducous and usually missing in herbarium material.

The inflorescence is a few-flowered, terminal or subterminal cyme, or flowers may occur singly or in groups in the axils of leaves. Usually there is a combination of these types, the young branch being itself a leafy "inflorescence." The pedicels are relatively short, scarcely ever as long as the flower, pubescent like the petiole, and usually more or less aggregated. Flowers are small to large in the *Malvaviscus arboreus* complex (1.5–5.5 cm. long),[12] very large in *Malvaviscus candidus* (about 8 cm. long), and are generally very showy, but not fragrant. They never open fully but remain as a contorted tube, each petal overlapping the next. The mature staminal column is exserted about one third its length beyond the petals.

The involucre (pl. 17, fig. 4), often designated as subcalyx or involucel, is conspicuous, more or less enclosing and hiding the calyx. It is usually densely pubescent with small stellate hairs, sometimes

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[12] In this monograph flower length indicates the distance from the base of the calyx to the tip of the petals, disregarding the exserted staminal column.

subglabrous. The involucral lobes are entire, linear to broadly lanceolate or obovate, varying in number (8 is a common number), and usually about as long as the calyx. They are attached to the pedicel immediately below the calyx and are persistent until maturity of the fruit.

The calyx (pl. 17, fig. 1) is campanulate, usually uniformly and densely stellate-pubescent without, sometimes subglabrous or with longitudinal ridges of hairs. On the inside it is short-lanose near the tips of the lobes, sub-lepidote below. The lobes are variable in number (generally five), essentially deltoid-lanceolate, and are usually unequal in size. The persistent calyx may or more often may not entirely enclose the mature fruit.

The petals (pl. 17, fig. 2) are five in number, asymmetrically obovate-cuneate, usually emarginate at the top, unguiculate toward the base and uncinate-auriculate on one side of the claw. On the outside they are slightly stellate-pubescent basally or subglabrous.

The thin, glabrous, staminal column (pl. 17, fig. 3) is usually one-third longer than the corolla and is five-lobed apically. The many unilocular, oval anthers are borne towards the tip on short filaments. From the top of the staminal column are exserted ten style branches, each with a capitate stigma. The ovary appears as a swelling at the base of the staminal column and is sessile, five-carpellate, five-ovulate.

The fruit (pl. 17, fig. 5) is depressed-globose, medium-sized in the *Malvaviscus arboreus* complex, but larger in *Malvaviscus candidus*. It consists of five stone-like, one-seeded carpels enclosed by a fleshy covering which soon dries, allowing the carpels to separate easily. A small reniform, basally attached seed is found in each carpel. Often only two or three of the carpels of the fruit mature.

Of the morphological characters, few seem to be of diagnostic value. The habit of the plant seems to vary with the environment, as does to some extent the type of inflorescence. The structure of branch, petiole, and pedicel is essentially uniform in the genus, as is the type of stipule. The internal structure of the flower is also essentially uniform throughout the *Malvaviscus arboreus* complex, just as it is, for example, in the Cruciferae, and is of little value for taxonomic delimitation within *Malvaviscus arboreus*. In addition, many herbarium sheets of *Malvaviscus* are with but one or two flowers, the removal and boiling of which would leave little critical flower material for the next observer. Also the type of fruit differs

significantly only between the *Malvaviscus arboreus* complex and *Malvaviscus candidus*, two species which are already amply separated on other characters. Moreover, herbarium specimens of *Malvaviscus* rarely contain fruit, and it would be impractical and unwise to base taxonomic units on this character unless absolutely necessary for a natural classification. The form of the involucre and of calyx is variable even on flowers of the same plant and is of taxonomic value only in a limited way. Similarly, type of leaf margin and structure of the staminal column offer little critical evidence to the taxonomist.

However, the fundamental difference in leaf shape, the type and degree of pubescence (in part), and the size of the flower seem to offer a broad basis for taxonomic segregation. Yet there is not a single character in the genus that by itself is of constant value for critical delimitation within the *Malvaviscus arboreus* complex.

TAXONOMIC RELATIONSHIPS AND SUGGESTED GENERIC CHANGES

Delimitation of taxonomic groups: The Malvaceae belong, of course, to the order Malvales of the Polypetalae. There has been great diversity of opinion as to how many families should be recognized in this order, from two to nine distinct families having been accepted by various authorities. However, since the early eighteen-hundreds the family Malvaceae has been distinct and generally recognized as an entity with essentially its modern limits, defined especially by the presence of unilocular anthers and monadelphous staminal column.

Within the Malvaceae subfamilies, tribes, and subtribes have been recognized chiefly on the basis of fruit characters. Perhaps the most useful and generally accepted division of the family is that of Gray,[13] in which he recognized, on the basis of number and arrangement of carpels, mode of dehiscence of the fruit, and morphology of the staminal column, four tribes: the Malopeae, Malveae, Ureneae, and Hibisceae. The tribe Ureneae, of which *Malvaviscus* is a member, is distinguished by having five uniovulate carpels, ten style-branches, the staminal column antheriferous along the upper part (but not at the truncate or five-toothed summit), and the seeds ascending, with a superior radicle. Among the genera included in this tribe are *Malachra, Urena, Pavonia,* and *Malvaviscus. Malvaviscus* is distinguished from the other genera

[13] Syn. Fl. N. Am. 1[1]: 294–338. 1897.

in having a "fleshy" or "drupaceous" fruit. However, the genus is apparently as closely related to *Pavonia* as are the "dry-fruit" genera of the Ureneae to one another.

Proposed generic changes: The dividing line between *Malvaviscus* and *Pavonia* has been difficult to recognize. Just where does the "dry" fruit of *Pavonia* stop and the "fleshy" fruit of *Malvaviscus* start? In the mature fruit of *Malvaviscus* the outer "fleshy" covering dries and finally ruptures exposing the carpels. In *Pavonia* the "dry" outer wall of the ovary holds the carpels together until maturity. The difference is in the thickness of the outer ovary wall which, however, in both genera becomes dry and ruptures at maturity of fruit. An additional and more distinct division between the two genera is possible by using the old Candollean character for subdivision of *Malvaviscus* into the sections *Anotea* and *Achania*, namely whether or not the petals are auriculate at the base. Even de Candolle questioned whether the section *Anotea* belonged in *Malvaviscus*. It is here proposed to transfer this section (raised by Kunth to generic rank) with its few and in some cases unrecognizable species to *Pavonia*. Thus *Pavonia* will include species without auriculate petals while *Malvaviscus* will include only those species with auriculate petals. This will necessitate the transfer of but two undoubted species of *Malvaviscus* to *Pavonia*, both of which evidently should be transferred anyway on fruit character alone. Thus *Malvaviscus Palmeri* Baker f. *(Malvaviscus cinereus* Baker ex Robins. & Greenm., *Pavonia amplifolia* Standl.) should be *Pavonia Palmeri* (Baker) Schery, and specimens heretofore incorrectly determined "ex char." as *Malvaviscus acerifolius* Presl should be *Pavonia firmiflora* Schery n.sp. Both of these species have a "dry" fruit as well as non-auriculate petals. They are treated in this monograph as excluded species.

Geographic and Climatic Range of the Genus

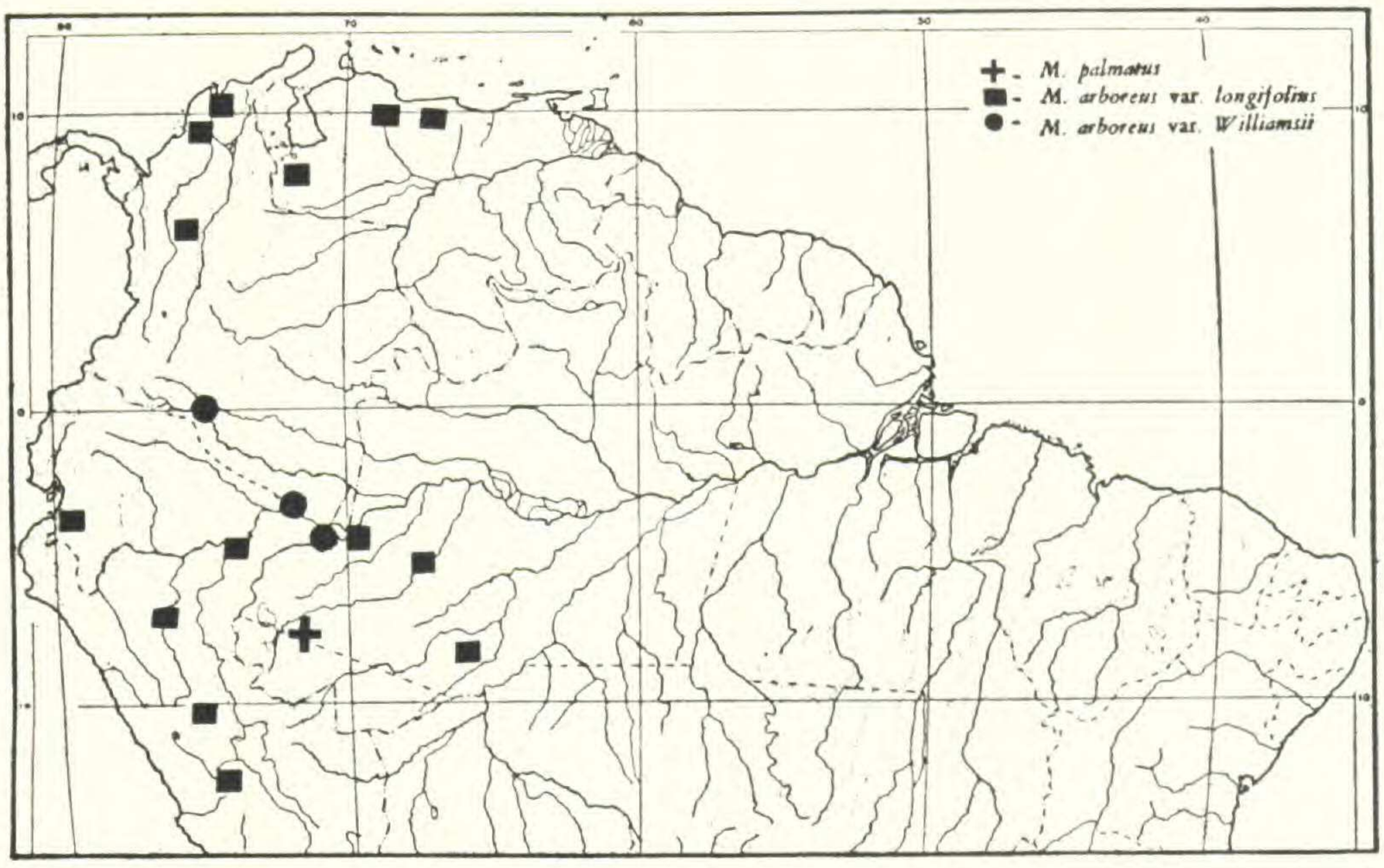
Malvaviscus is native to the Western Hemisphere, although a few plants have evidently been introduced into the Philippines and Malaya and are growing there as escapes. The genus occurs indigenously from Peru and northern Brazil to the southern United States and also in the West Indies. *Malvaviscus arboreus* and its varieties are distributed generally throughout this range. The other species are found only in limited areas, one in central Mexico, another in Brazil. *Pavonia firmiflora* and *Pavonia Palmeri* (heretofore included in *Malvaviscus)* are confined to western Mexico.

Maps 1–6 show the present known distribution of the species and varieties of *Malvaviscus* and of the two above-mentioned species of *Pavonia*. It is interesting to note that certain groups have be-

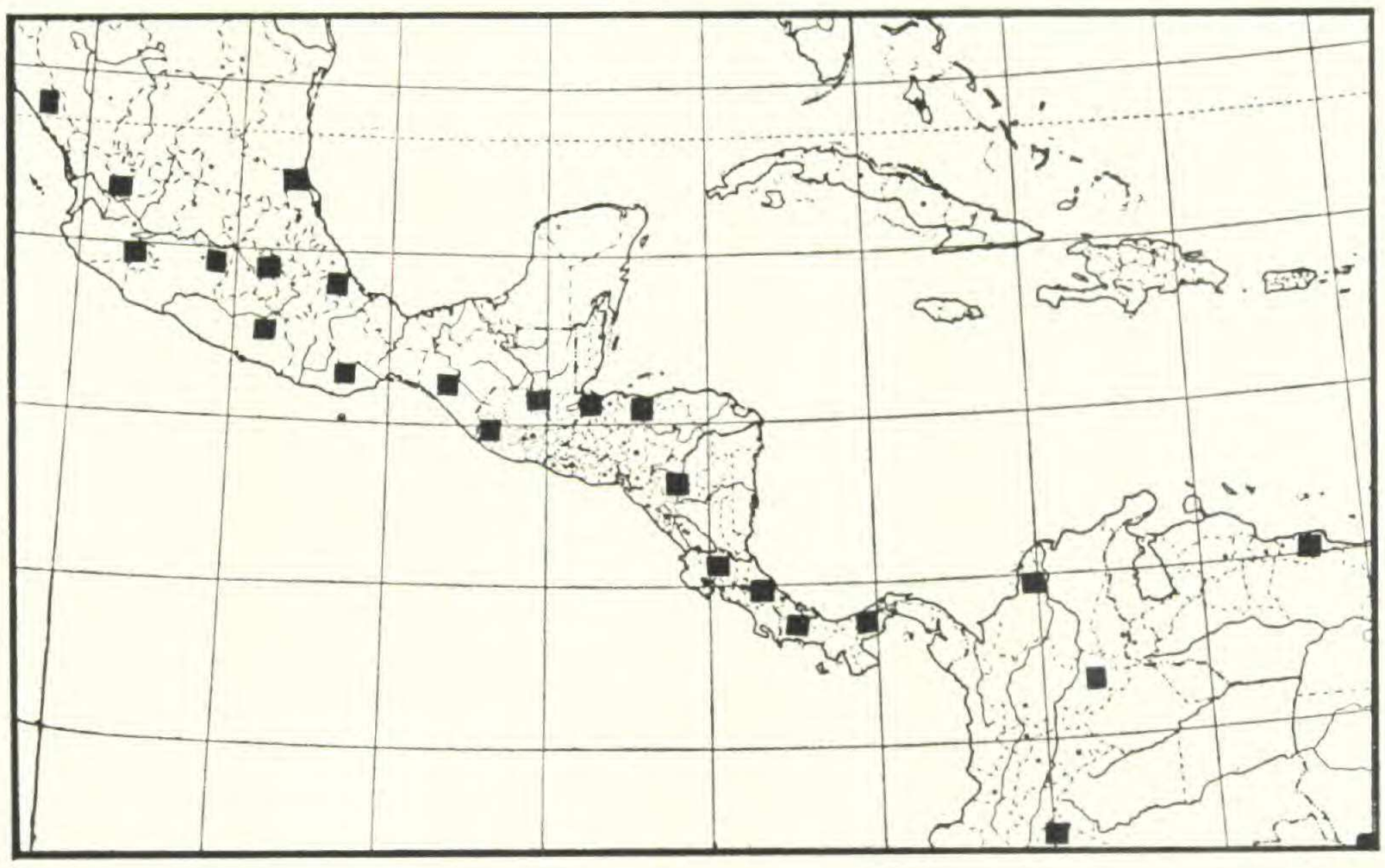
Map 1. Showing distribution of *M. arboreus*.

Map 2. Showing distribution of *M. candidus* and *M. arboreus* vars. *brihondus*, *cubensis*, *Drummondii*, *Hintoni*, *palmanus* and *sepium*.

come locally segregated and divergent enough to warrant varietal classification (vars. *palmanus, brihondus, sepium, Hintoni,* etc.), while others are very widespread, overlapping, and more or less



Map 3. Northern South America showing distribution of *M. palmatus* and *M. arboreus* vars. *longifolius* and *Williamsii.*

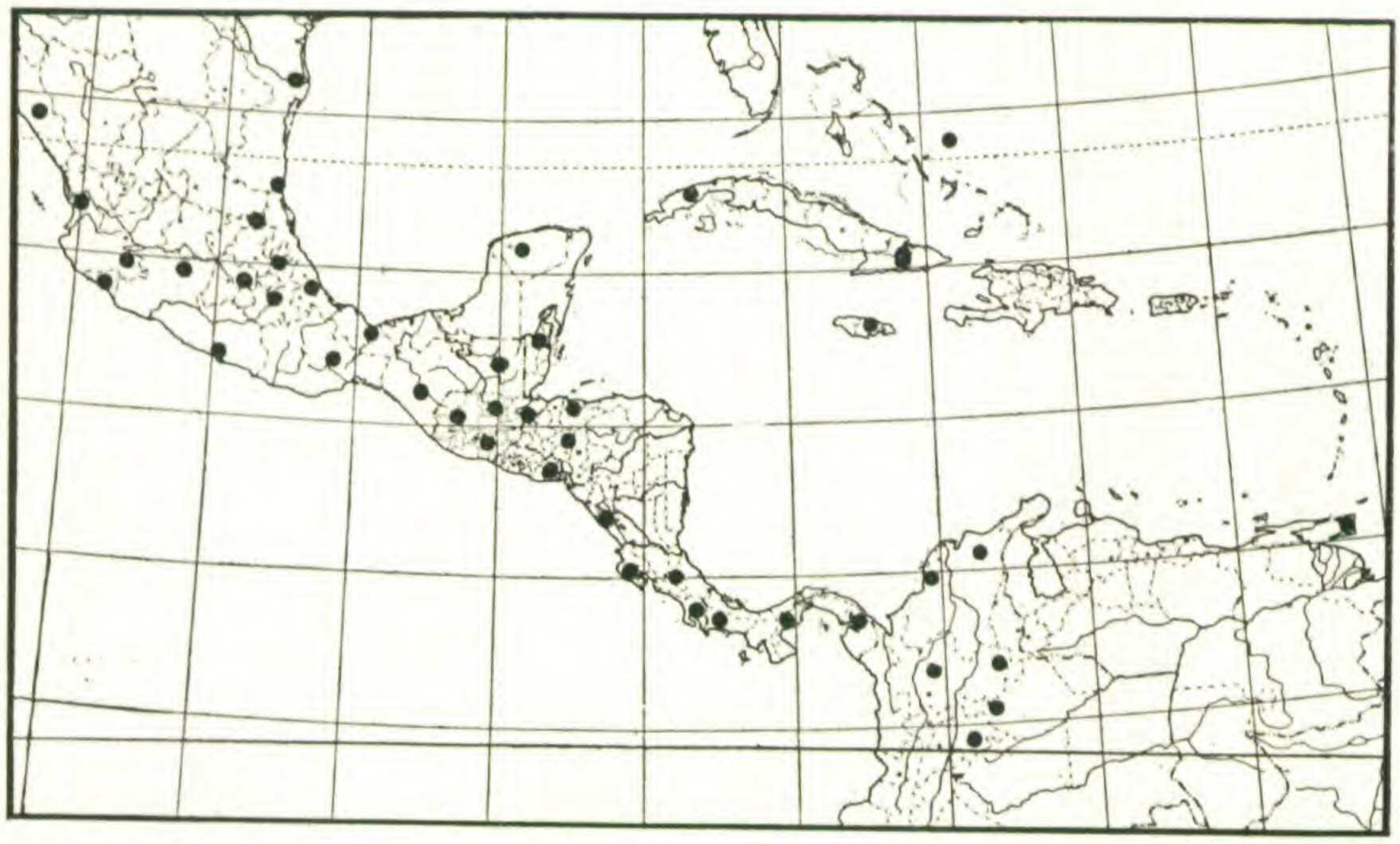


Map 4. Showing distribution of *M. arboreus* var. *penduliflorus.*

artificially delimited, evidently the parent stock from which local segregations are occurring *(Malvaviscus arboreus* and vars. *penduliflorus, mexicanus,* etc.).

Malvaviscus is quite tolerant of geographic-climatic differences. It is found growing from near sea-level to highlands of 2500 meters

as, for example, in Panama, where plants can be found within sight of mangrove swamps (Puerto Armuelles) while about a hundred kilometers towards the interior it is abundant near the lower slopes



Map 5. Showing distribution of *M. arboreus* var. *mexicanus*.

Map. 6. Map of Mexico showing distribution of *P. firmiflora and P. Palmeri.*

of Volcan de Chiriquí. In Mexico the genus is found in the hot, steaming forests of the Tehuantepec Peninsula and the high, cool plateau region near Mexico City. Plants of northwest Mexico and Texas grow in open semi-arid regions (damp river bottoms, etc.)

while those of Costa Rica and Panama may occur in dense rain-forests. Apparently there are ample geographic-climatic forces pressing for speciation. That these forces have had relatively little effect (in the sense of forming distinct, isolated species) testifies again as to the plasticity and variability of the genus.

Evidence for Taxonomic Conclusions

Study of natural populations: In *Malvaviscus,* populations, in the sense that the term is used for dense, isolated groupings or clusters of herbs and shrubs in the United States, do not occur. Rather, whole regions, perhaps several kilometers in extent, are found in the tropics where the plants are relatively abundant. Scarcely ever more than three or four separate plants grow side by side, and numerous single individuals occur frequently. The plants trail over shrubbery, are more or less shrub-like in open areas, and frequently in the forest can be found liana-like reaching almost to the tops of the trees. A single plant may spread over an area seven or eight meters in diameter and perhaps overlap partly the area occupied by another *Malvaviscus.*

In no case have I found hundreds of *Malvaviscus* plants within a small area, able to be collected, analyzed and counted, as are many North American plants used in population studies. Nevertheless, in areas even kilometers in extent, as, for example, moist stream banks, it seems plausible to assume that all the plants of this genus are apt to be rather closely related inasmuch as it may be tens or even hundreds of kilometers before another such area is encountered.

Examination of a young stem in flower from every accessible plant in such an area in Chiriquí, Panama, showed that a general similarity in certain characters existed (viz. general leaf shape; broader structural features of calyx, corolla, etc.), but that tremendous individual variation in certain specific characters (viz. number, length, and shape of calyx and involucre lobes, type of serration of leaf, continuity of pubescence, etc.) was also evident. It is not hard to imagine that a taxonomist unfamiliar with the genus, given two extremes from the "population," might consider the specimens as different species. Yet all intergrading degrees of variation exist, sometimes even on the same plant. The only conclusion that seems tenable is that individuals of *Malvaviscus* exhibit great variability, whether due to ploidy, hybridization, or other causes. Photographs of some specimens from this "popula-

tion'' are presented in plate 15. Similar examination of a ''population area'' in Vera Cruz, Mexico, though not as extensive, supported these findings on individual variabilty.

Examination of greenhouse plants: That certain variations in leaf shape are of no taxonomic value (although, as will be shown directly, the manner of variation may be significant) can be shown by examination of living *Malvaviscus* plants. On the same plant from comparable stems can be found both semi-lobed and unlobed leaves. Figure 1 of pl. 16 shows two leaves from a plant which had been growing in the greenhouse of the Missouri Botanical Garden for a number of years. That these greenhouse plants, evidently brought from southern Mexico, had the potentiality for ''acting queer'' as far as leaf shape is concerned, was demonstrated when cuttings were made and rooted. The first-formed leaves of the cuttings were unlike any leaf ever seen on the parent plant, although genetically parent and scion were the same. However, after about eight or nine nodes, the cuttings developed leaves like the parents. A photograph of one such cutting appears in pl. 14.

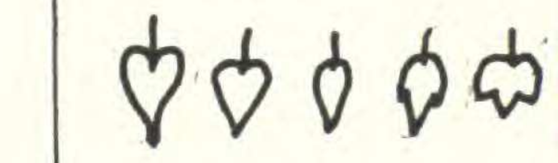
Examination of herbarium material: From limited examination of living plants of *Malvaviscus,* it was evident that great variability was to be expected in herbarium material of the genus, and that many of the characters which normally (i.e., in other genera in other families) might be constant and of definite systematic value were worthless here.

Examination of all available herbarium material of *Malvaviscus* shows complete intergradation of all forms in the *Malvaviscus arboreus* complex. Segregation of specimens of different appearance can be accomplished only with overlappings and intergradations. Intense segregation leads to a multitude of intergrading forms all of slightly different appearance (over 100 such segregated forms, all marginally indistinct, are possible in sorting *Malvaviscus* specimens). Obviously such intense segregation is worthless in any genus as variable as *Malvaviscus.* It leads to nothing more than artificial forms to which must continually be added others as more specimens are collected. Keying out of such forms is impossible, even on a distributional basis alone.

Thus in order to find some clear-cut specific characters of taxonomic value in the *Malvaviscus arboreus* complex, individual characteristics were scrutinized separately in a series of specimens ranging from South America to Texas. In approximately 400 specimens examined for distinctive characters in leaf shape, pubescence

TABLE I

NUMBER OF SPECIMENS FROM DIFFERENT LOCALITIES SHOWING CONTRASTING CHARACTERS.

	leaf shape					leaf pub.		petiole		stem pub.		involucre lobes			flower length			leaf length			leaf margin			
						simple	stellate	pubescent	pilose	continuous	decurrent	thin	interm.	wide	> 4.5 cm.	3-4.5 cm.	< 3 cm.	long	interm.	short	jagged	serrate	dentate	sinuate
Peru	6	2	0	9	0	12	5	10	7	5	12	9	7	0	0	4	8	0	3	14	4	1	5	7
Brazil	3	3	0	0	0	1	2	2	1	0	3	4	2	0	0	2	3	0	0	6	1	3	0	2
Venezuela	3	4	0	1	0	2	5	8	0	4	4	0	2	6	0	4	4	0	4	3	1	4	1	2
Colombia	6	5	0	1	0	8	1	7	3	3	6	1	8	2	0	8	1	0	2	9	1	3	4	2
Panama	10	25	1	1	0	36	1	31	6	21	14	1	13	23	0	28	7	2	16	18	6	6	14	14
Costa Rica	0	16	14	7	2	24	11	34	3	12	24	0	16	19	2	16	13	5	16	15	3	11	9	11
Nicaragua	0	0	3	3	1	1	5	6	0	0	7	0	6	0	3	4	0	1	5	1	0	2	1	4
Honduras	0	13	4	2	0	11	9	18	1	5	15	0	6	15	0	12	7	0	11	9	6	3	4	7
Salvador	0	1	0	1	1	0	3	3	0	0	3	0	0	3	1	2	0	0	3	0	0	0	3	0
Br.Honduras	0	2	11	0	0	13	0	12	2	4	9	0	9	4	12	0	0	3	8	2	1	1	10	1
Guatemala	0	22	14	10	3	30	19	32	13	16	35	1	19	28	10	28	5	8	28	15	10	8	23	10
Yucatan	0	26	4	2	0	29	2	29	3	7	23	4	22	5	25	2	0	9	21	1	4	3	22	0
So. Mexico	0	9	2	4	1	11	5	14	2	10	6	0	11	4	7	6	2	4	11	1	1	1	10	1
West Mexico	0	11	1	2	0	4	10	13	1	6	8	0	5	9	5	7	1	2	5	7	1	1	12	0
Cent.Mexico	1	6	4	9	3	10	13	23	0	11	12		13	9	6	9	4	3	14	6	0	7	13	3
East Mexico	0	17	3	5	0	7	17	23	2	19	6	3	17	5	19	4	1	9	15	1	1	1	14	9
No. Mexico	0	3	0	2	4	1	8	8	1	5	4	0	5	4	6	3	0	3	6	0	0	2	6	1
So. Texas	0	0	0	13	18	3	29	31	0	7	25	0	19	13	24	6	0	3	21	8	4	6	26	2
Cent.Texas	0	0	0	4	18	0	22	21	0	2	20	0	10	12	19	1	0	1	14	7	0	4	14	4

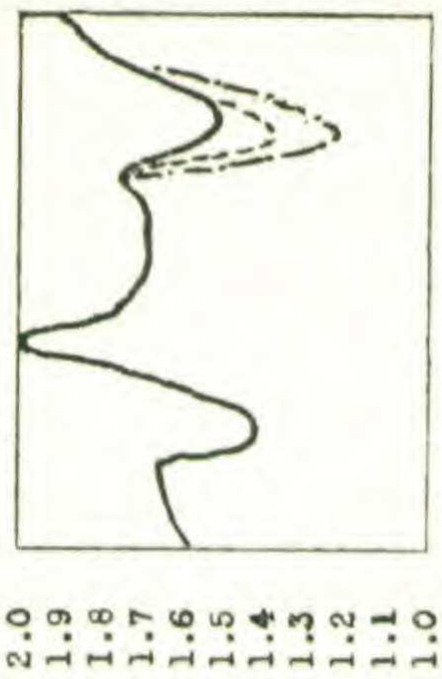


Fig. 4. Presence of decurrent ridges of hairs.

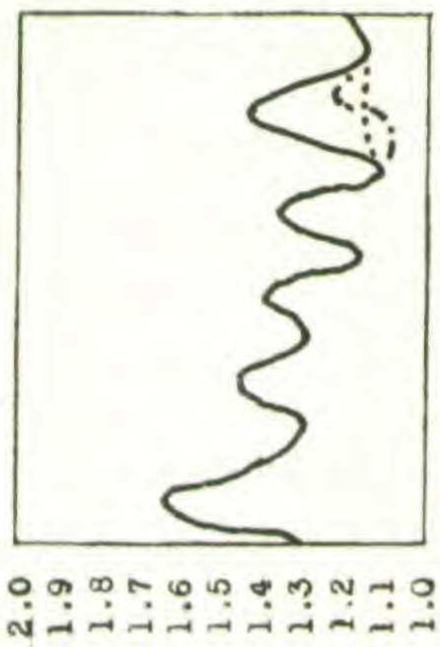


Fig. 8. Type of leaf margin.

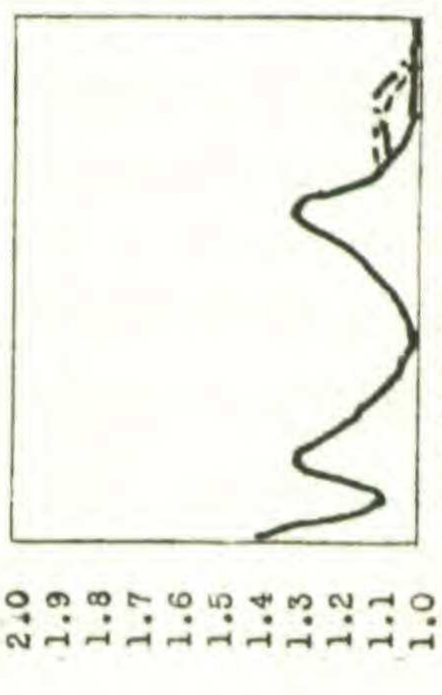


Fig. 3. Type of pubescence of petiole.

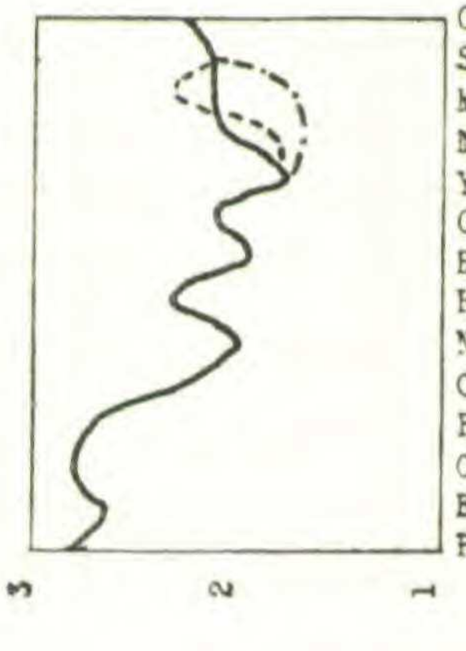


Fig. 7. Leaf length.

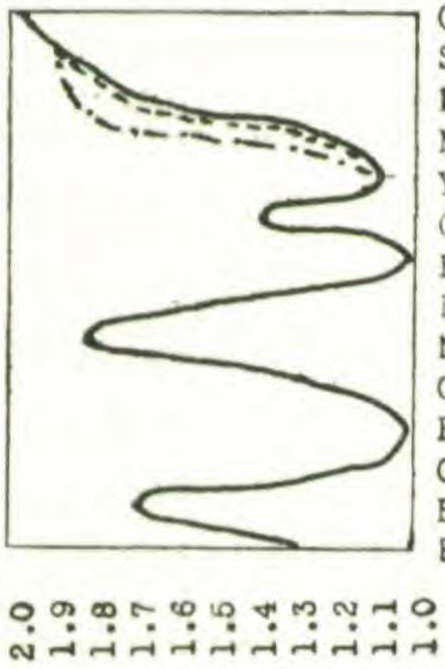


Fig. 2. Pubescence of lea

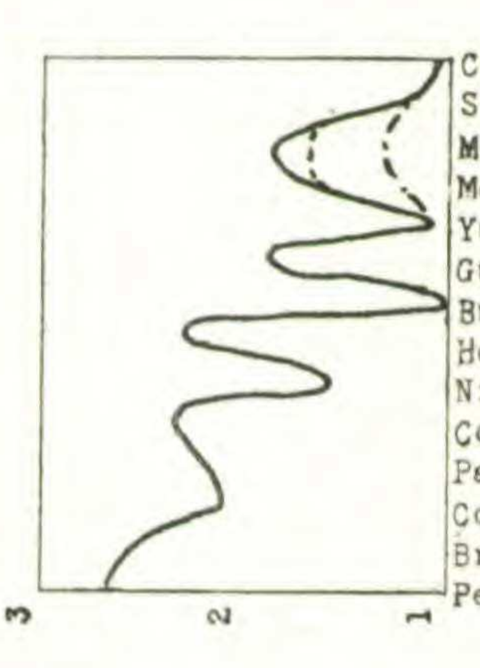


Fig. 6. Flower length.

Fig. 1. Leaf

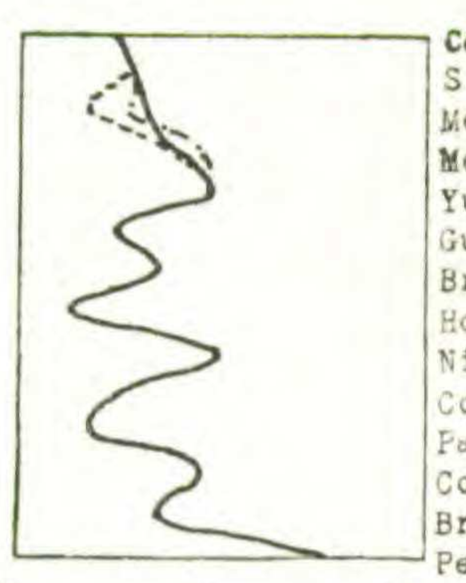


Fig. 5. Width of lobes.

of leaf, of petiole, and of stem, shape of involucre lobes, length of flower and of leaf, and type of leaf margin, not a single clear-cut difference was found. Later examination dealing with the number of flowers per inflorescence, presence or absence of petiole callus, relative length of the staminal tube, type of venation, pubescence of veins, and concentration of stamens, showed a similar lack of clear-cut characteristics in Panamanian specimens alone.

However, one point of significance was noted about several of these characters: they differed, *on the average*, for specimens from different geographical areas. Thus in Colombia leaves of specimens, by and large, are broad and cordate at the base, whereas in British Honduras "average" leaves are narrow and rounded. Again, flowers in South American specimens, although often the same length as those in Texas specimens, show an *average* length significantly greater than the *average* for Texas flowers.

Table I gives the tabulated results of these examinations, and figs. 1–8 show these results put into graph form for individual characters. Of course the intrinsic value as read from the ordinants of these graphs (geographical distribution read from abscissas) is not significant. These values were obtained in mathematical form by arbitrarily assigning one extreme of a given character a high number, the other extreme a low number. Then an average for all specimens of the region was taken and tabulated. Thus if half the specimens showed the high number character and half the low, the average would be midway between these two. Significance for the character can only be assumed when there is a pronounced rise or dip in the curve at a certain geographical region. For example, reference to figs. 1–8 will show a steep dip or rise for many characters in the region of British Honduras. From this it can be assumed that the available British Honduran specimens are more or less constantly different in many ways from those of neighboring regions and probably constitute a taxonomic unit.

Yet examination of these graphs as a whole shows a remarkable lack of "significant characters" for any one region. Rather, the dips occur indiscriminately for various characters, now in one geographical region now in another. With one or two exceptions, there is no continuous gradation of characters from South America to North America.

These results were assumed to indicate further that in the *Malvaviscus arboreus* complex, there are no clear-cut, distinctly different taxonomic units, at least as far as geographical distribution is con-

cerned. In other words, that although no distributional differences of specific degree existed, perhaps numerous overlapping groups, viz. from British Honduras, Texas, etc., were deserving of varietal separation. Also it seemed that of the characters examined, basic leaf shape and length of flower were perhaps fundamental and would be of value as key characters. The other characters, seemingly, were useless or of limited value. Of course it must be remembered that tabulations and investigations of this kind are apt to show up only degrees of differentiation due to geographical isolation, and may or more probably may not show speciation due to biological isolation. However, in a genus such as *Malvaviscus*, where scarcely a constant character is to be found, any approach that may give a hint as to natural groupings is worth investigation.

Hybridization evidence: In another line of attack on the problem of taxonomy in the *Malvaviscus arboreus* complex, hybridization was attempted between var. *Drummondii* (Texas) and var. *penduliflorus* (southern Mexico?) growing in the Missouri Botanical Garden greenhouses. Although both varieties flower abundantly in the greenhouse, their blooming seasons do not coincide but do partly overlap. Variety *penduliflorus* blooms through the winter, spring and early summer; var. *Drummondii* in the autumn and sporadically at other times. This discrepancy between blooming seasons can be accounted for by the latitudinal season and day-length differences of the regions to which these varieties are indigenous.

Flowers of both varieties were early castrated, hand-pollinated a day or two later with pollen from the other variety, and then bagged (both opaque and translucent paper bags were tried). However, in no case would var. *penduliflorus* flowers set seed, even when self-pollinated. This was evidently due to greenhouse conditions, for greenhousemen cannot recall ever having seen this variety set seed at the Missouri Botanical Garden. Neither did any *Drummondii* flowers pollinated with *penduliflorus* pollen set seed; but so few *Drummondii* flowers were available at the proper time that this result is not significant. Normally, only a very small percentage of *Drummondii* flowers set seed in the greenhouse, even when self-pollinated. Thus from attempted greenhouse hybridizations, no conclusions could be reached as to the closeness of relationship in these two varieties. However, an incidental observation noted in herbarium material seemed to be supported: that there is an inverse relationship between the flower length in *Malvaviscus* and quantity of seed set. Smaller-flowered plants (as var. *Drummondii)* seem

to set more seed than larger-flowered ones (as var. *penduliflorus*), perhaps due to the fact that the pollen tube must push farther through the style in long-flowered types with a consequent lesser chance of reaching the ovary.

Even though no evidence that hybridization is possible in *Malvaviscus* was obtained from the greenhouse experiments, much circumstantial evidence exists that hybridization does occur in the genus. Firstly, many plants are intermediate in character and have never been exactly duplicated in later collections (specimens of *Malvaviscus arboreus, Pavonia firmiflora,* etc.). Secondly, geographic distribution of varieties makes contact possible with many other varieties (extended and overlapping range of *Malvaviscus arboreus* and such varieties as *mexicanus, penduliflorus,* etc.). Thirdly, there is usually a low percentage of flower fertility in living plants (plants examined in the field in Mexico, Costa Rica, and Panama showed that very few fruits matured in proportion to the number of flowers produced). Fourthly, hybridization is evidently not uncommon in the family Malvaceae (Kearney[14] on *Sphaeralcea,* Webber[15] on relationship in *Gossypium,* Skovsted[16] on chromosome numbers in the Malvaceae, etc.). In all probability appropriate experiments by competent geneticists and cytologists would show varietal hybridization to be exceedingly common in *Malvaviscus,* and even intergeneric hybridization with *Pavonia* possible.

Chromosome counts: Lack of proper technique by the author in making microspore chromosome counts, probably more than natural difficulties in the genus, made investigations along this line of no taxonomic value. Aceto-carmine smears of young pollen showed occasional evidence of a great many chromosomes, but these were so abundant, indistinct, and obscured by debris that counts were impossible. However, Skovsted[17] reports the occurrence of a diploid count of 84 chromosomes in *Malvaviscus.* This number fits in with the basic chromosome number of 7 found in the tribe Ureneae, a number Davie[18] would like to consider as basic for the family as a whole but which others (viz., von Kesseler,[19] Webber,[20] Skovsted,[17]

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[14] Univ. Calif. Pub. Bot. **19**: 1–128. *pls. 1–12. 1 fig.* 1935.

[15] Webber, J. M., in Jour. Agr. Res. **58**: 237–261. 1939.

[16] Skovsted, A., in Jour. Genet. **31**: 263–296. 1935 *(Malvaviscus,* p. 285); in Compt. Rend. Lab. Carlsberg **23**: 195–242. 1941.

[17] loc. cit. 1935 and 1941.

[18] Davie, J. H., in Jour. Genet. **28**: 33–67, *2 pls.* 1934.

[19] Kesseler, E. von, in Am. Jour. Bot. **19**: 128–130, *pl. 9.* 1932.

[20] Webber, J. M., in Science, N.S. **81**: 639–640. 1935.

Harland,[21] etc.) find unacceptable as ancestral for the entire Malvaceae. Although chromosome counts have scarcely been attempted in *Malvaviscus*, it is to be expected that when such are made a high degree of ploidy, perhaps to the octoploid or decaploid, will be found as in other Malvaceous genera.

Conclusions: From these several lines of investigation a conservative taxonomic treatment for the genus seems necessary. Since clear-cut, stable morphological characters of taxonomic value are lacking, lines of demarcation must necessarily be rather arbitrary and inclusive. Evidently the taxonomy should be made practical as well as following the indistinct varietal groupings as much as possible. Since the pattern of relationships is evidently reticulate through hybridizations rather than linear by descent, a key can only be constructed which may include closely related specimens in all of its main subdivisions. There is bound to be great varietal variability, and often the delimitation of a variety will need be arbitrary. Few groupings will deserve specific rank, since all intergrade and few show any evidence of either biologic or geographic isolation. In short, *Malvaviscus* (i.e. the *Malvaviscus arboreus* complex) seems best pictured as a reticulate background of several intermixing varieties *(Malvaviscus arboreus*, vars. *penduliflorus, mexicanus*, etc.) on which several newer varieties (vars. *palmanus, brihondus, sepium*, etc.) have superimposed themselves locally, perhaps due to a new favorable but non-isolating "mutation."

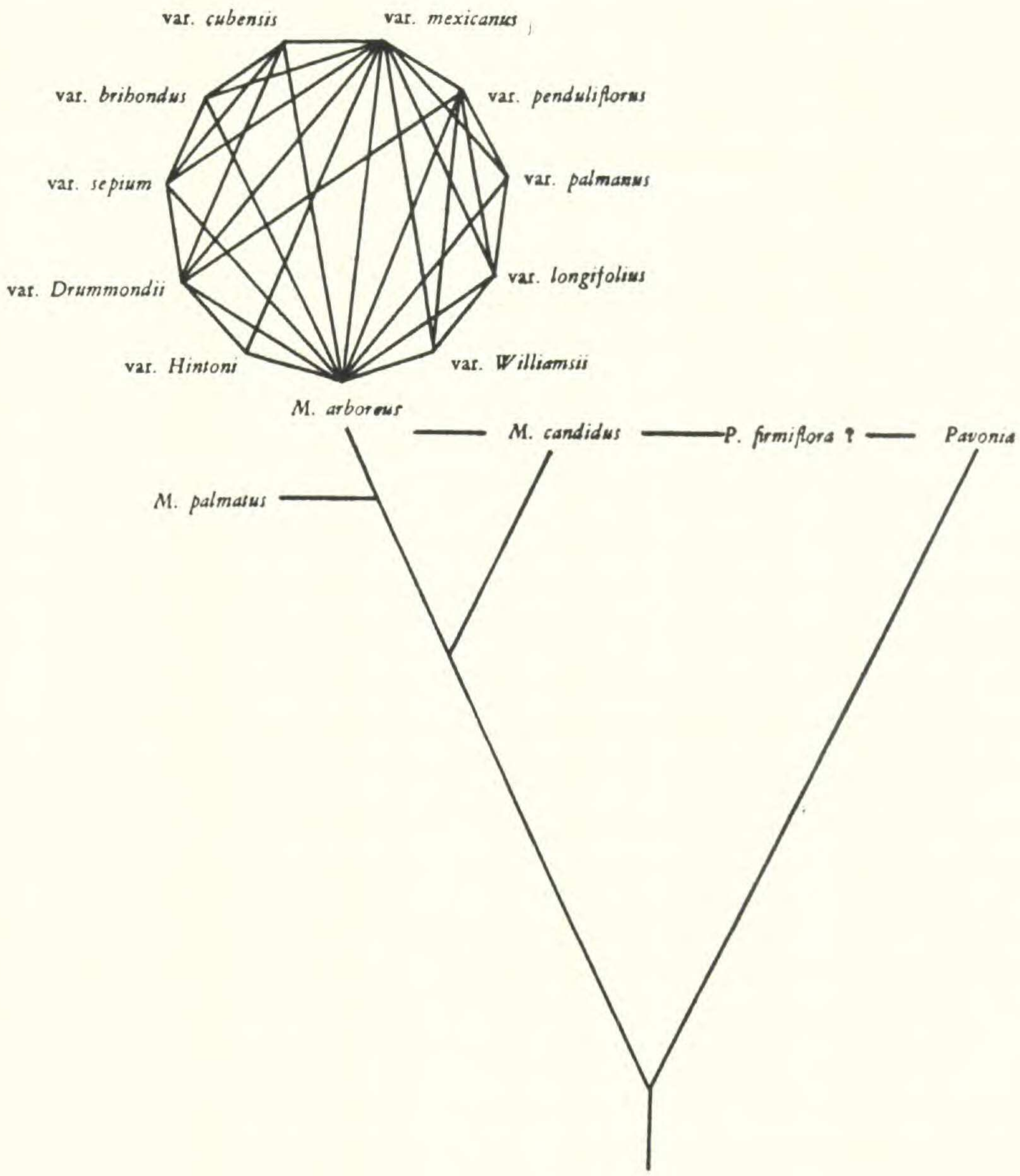
PHYLOGENETIC INFERENCES

Although it is extremely hazardous to venture phylogenetic opinions, certain hypotheses can be presented regarding relationship of taxonomic groups and their derivation. From the previously mentioned circumstantial evidence concerning *Malvaviscus* and the Malvaceae as a whole, it seems reasonable to suppose that *Malvaviscus* is made up of a number of types, probably polyploid, which have not as yet become genetically isolated (except perhaps, *Malvaviscus candidus)* and are only partially geographically isolated. These types *(Malvaviscus arboreus* and its varieties) have evidently crossed back and forth with one another extremely often. As a result there is a reticulate relationship between *Malvaviscus arboreus* and its varieties, the biggest mixup occurring in southern Mexico. Marginal groups as vars. *Drummondii* in Texas, *Wil-*

[21] Harland, S. C. The Genetics of Cotton. London, Toronto. 1939.

liamsii in Peru, and perhaps *brihondus* of British Honduras and *palmanus* of Costa Rica, are probably the "purest" but nevertheless intergrading types. The promiscuous exchange of characters, possibly coupled with degrees of ploidy, could, at least in part, account for the great variability and intensification of phenotypes even in small populations.

TABLE II



URENEAE

The genus as a whole is closely related to *Pavonia* and may have split off from that genus rather recently. Assuming this to be the case, *Malvaviscus* is in an early stage of speciation within itself, the numerous varieties as yet lacking barriers which would lead to complete speciation. *Malvaviscus candidus* must have been an early segregation from the *Malvaviscus arboreus* complex, perhaps oc-

curring soon after the split with *Pavonia*. The same may be true for *Malvaviscus palmatus*, or this species may be a broadcross hybrid or a monster. Table II represents a possible phylogenetic "tree" for *Malvaviscus*. Actually the figure should be three dimensional with all the *Malvaviscus arboreus* varieties at about the same level. Also it is not intended to show "pure" lineage for the Ureneae, for this tribe in its early stages may have had interconnections with *Hibiscus*-like forms, etc.

COMMON NAMES AND USES

Malvaviscus has been recognized by many peoples who have given vernacular names to the plant. As mentioned previously, an early Aztec name for *Malvaviscus* was "Atlat Zopillin."[22] A supposed Maya name is "taman chich." The Maya-Spanish name for the plant was "manzanita," a name still used in many parts of Central America. Other names reportedly used today in Latin America for *M. arboreus* and its varieties are: "algodoncillo," "amapola," "amapolilla," "arete," "arito," "candelillo," "chilito colorado," "chilmecate," "chocho," "claveloncillo," "esbequen blanco," "flor de arito," "flor de avispa," "fucsia silvestre," "manzana," "manzanilla," "manzanita guesillo," "mapola," "monaguillo," "monacillo," "monecillo," "obelisco," "panelita," "papito de monte," "para tisano" (for root), "pico de gorrion," "quesillo," "quesito," "resuscitado de monte [mente?]," "sobon," "tulipancia," "uba," and doubtless several others. *M. candidus* is known as "monacillo blanco." "Waxmallow" and "Turk's-cap Hibiscus" are two English names for *M. arboreus* var. *penduliflorus*, which is frequently cultivated as an ornamental in our southern states where it has been introduced, evidently from Mexico. "May-apple" is the name given to *Malvaviscus arboreus* var. *Drummondii* in Texas where the fruits are reported to be eaten both raw and cooked. *Malvaviscus arboreus* is also reportedly called "sugar bark" in Jamaica.

Perhaps the reason why *Malvaviscus* has acquired so many local names in Central America is that it is of some economic importance to the natives, and thus attention has been focused on it. Rubbing the head with leaves of the plant supposedly cures scaly head, and

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[22] The early Spanish explorer, Francisco Hernandez, who was sent to Mexico by Philip II from 1570 to 1576 as expedition naturalist, records this name in his 'Nova Plantarum, Animalium, Mineralium Mexicanorum Historia,' which was published at Rome in 1651.

a decoction of the leaves is said to be used as a diuretic and in treatment of stomach ailments. Also the fruit of *Malvaviscus* is edible, though scarcely appetizing.

Taxonomy

Abbreviations used in this section

A—Arnold Arboretum Harvard University, Jamaica Plain, Massachusetts.
F—Field Museum of Natural History, Chicago, Illinois.
G—Gray Herbarium of Harvard University, Cambridge, Massachusetts.
L—Museo de Historia Natural de la Universidad de Lima, Lima, Peru.
M—Missouri Botanical Garden, St. Louis, Missouri.
NY—New York Botanical Garden, New York City.
US—United States National Herbarium, Smithsonian Institution, Washington, D. C.

MALVAVISCUS [Dill.] Adans.

Malvaviscus [Dill. Hort. Elth. **2**: 210. *pl. 170. fig. 208.* 1732] Adans. Fam. **2**: 399. 1763; Cav. Tert. Diss. Bot. 131. *pl. 48, fig. 1.* 1787; Medic. Malv. 49. 1787; Juss. Gen. Plant. 304. 1791; Moench, Meth. Suppl. 208. 1802; HBK. Nov. Gen. & Sp. **5**: 285. 1821 [1822]; DC. Prodr. **1**: 445. 1824; Descourt. Fl. Ant. **6**: 11. *pl. 383.* 1828; G. Don, Gen. Hist. Dichl. Pl. **1**: 475. 1831; Presl, Reliq. Haenk. **2**: 135. 1835; Endl. Gen. Pl. 982. 1836–40; A. Rich. Bot.—Pl. Vasc., in Sagra, Hist. Nat. Cuba, 131. 1845(?); Gray, Gen. Pl. U. S. 77. *pl. 131.* 1849; Benth. & Hook. Gen. Plant. **1**: 206. 1862; Baill. Hist. Pl. **4**: 148. 1873; Hemsl. Biol. Cent.-Am. Bot. **1**: 118. 1879; K. Schum. in Engl. & Prantl, Nat. Pflanzenfam. **3**^{6}: 46. 1890; Mart. Fl. Bras. **12**^{3}: 535. 1892; Gray, Syn. Fl. N. Am. **1**: 297, 332. 1897; Small, Fl. S.E. U. S. 733. 1913; Standl. in Contr. U. S. Nat. Herb. **23**: 773. 1923.

Hibiscus L. Sp. Pl. **2**: 694. 1753, in part; Browne, Hist. Jam. 284. 1756.

Achania Sw. Prodr. Fl. Ind. Occ. 102. 1788; Ait. Hort. Kew. **2**: 459. 1789; Schreb. in L. Gen. Plant. ed. 8, **2**: 469. 1791; Sw. Fl. Ind. Occ. **2**: 1221. 1800; Willd. in L. Sp. Plant. **3**: 839. 1801; Spreng. in L. Syst. Veg. ed. 16, **3**: 100. 1826.

Pavonia Cav. Ic. **5**: 20. *pl. 434.* 1799, in part; DC. Prodr. **1**: 445. 1824, as syn.

Anotea (DC.) Kth. ex Ulbrich in Fedde's Rep. Spec. Nov. **14**: 108. 1915, as doubtful section in DC. Prodr. **1**: 445. 1824.

Perennial vine-like or shrub-like plants with many-branched gray-brown terete stems. Leaves alternate, stipulate (stipules caducous), petiolate, variously lobed, usually stellate pubescent, especially on lower surface. Inflorescence leafy, with single axillary flowers or with terminal or subterminal cyme-like clusters of flowers. Involucre of 6–16 entire, linear, lanceolate, or spatulate lobes. Calyx campanulate, usually with 5 lanceolate or deltoid lobes, variously pubescent. Corolla contorted, tube-like, never expanded. Petals 5, obovate-cuneate, usually emarginate, unguiculate and auriculate basally. Staminal column exserted, 5-parted apically, bearing many stamens toward the apex. Style branches 10, each with capitate stigma. Ovary 5-carpellate. Fruit with outer fleshy covering (dry at maturity) surrounding five stony carpels. Carpels 1-seeded, indehiscent but often separating at maturity when outer covering dries.

Type species: **Malvaviscus arboreus** Cav. Tert. Diss. Bot. 131, *pl. 48, fig. 1.* 1787.

KEY TO THE SPECIES AND VARIETIES

A. Flower large, petals about 8 cm. long; staminal column about 12–15 cm. long, more or less curved-ascending; filaments about 1 cm. long.....*1. M. candidus*

AA. Flower smaller, petals less than 6 cm. long; staminal column less than 7 cm. long, not curved-ascending; filaments less than 3 mm. long.

B. Leaves palmately or digitately lobed (known only from type description of greenhouse plant).....*2. M. palmatus*

BB. Leaves less deeply lobed, sublobate, or unlobed, never palmately or digitately lobed.

C. Leaves lobed or sublobate.

D. Lateral lobes of leaves usually manifest and more or less acute; branchlets, petioles or lower leaf-surface very densely hairy, often velvety (occasionally lightly pubescent or hirsute, or almost glabrous, but then lobes of leaves usually large and very prominent); upper leaf-surface usually predominantly stellate-haired; involucral lobes never foliaceous; flowers red.....*3. M. arboreus*

DD. Lateral lobes of leaves obtuse or small; branchlets, petioles and lower leaf-surface variously pubescent but usually not with long dense hairs; plants either with upper leaf-surface more or less predominantly straight-haired, with leaves lightly pubescent and scarcely lobate, with involucral lobes foliaceous, or with whitish flowers....(vars. of *M. arboreus)*

E. Leaves slender (decidedly longer than broad), with shallow jagged lobes, rounded or but slightly cordate at base; involucral lobes never foliaceous.

F. Flowers white; central Mexico.....*3d. M. arboreus* var. *Hintoni*
FF. Flowers red; Mexico to South America, West Indies.
G. Flowers more than 4.2 cm. long, robust.....
.....*3h. M. arboreus* var. *penduliflorus*
GG. Flowers 2.3–4.2 cm. long.....*3f. M. arboreus* var. *mexicanus*
GGG. Flowers less than 2.3 cm. long; chiefly West Indian.....
.....*3b. M. arboreus* var. *cubensis*
EE. Leaves broad (as broad or nearly as broad as long), usually conspicuously cordate at base.
H. Involucral lobes expanded and more or less foliaceous, broadly lanceolate; South America.....*3j. M. arboreus var. Williamsii*
HH. Involucral lobes linear, linear-oblanceolate, or linear-ovate, usually broadest at or above the middle.
I. Leaves uniformly and symmetrically obtuse-lobate; pubescence of the upper leaf-surface almost always predominantly simple; branchlets and petioles usually uniformly short-pubescent; Gulf States of the United States and Mexico.....*3c. M. arboreus* var. *Drummondii*
II. Lobed and unlobed leaves on same plant or lobes irregular and varying in size; pubescence of upper leaf-surface usually predominantly stellate; branchlets and petioles usually glabrous, scabrous, long-haired, or with longitudinal ridges of hairs; Central Mexico to South America; West Indies.
J. Calyx slightly (less than twice) longer than broad, subturbinate, or short-cylindric with more or less flaring or spreading lobes, tube scarcely longer than fruit.
K. Flowers more than 4.2 cm. long, robust.....
.....*3h. M. arboreus* var. *penduliflorus*
KK. Flowers 2.3–4.2 cm. long.....*3f. M. arboreus* var. *mexicanus*
KKK. Flowers less than 2.3 cm. long; chiefly West Indies.....
.....*3b. M. arboreus* var. *cubensis*
JJ. Calyx about twice as long as broad, long-cylindric, with tube manifestly longer than fruit, contracted above fruit and enclosing it; leaves almost always unlobed; South America.....
.....*3e. M. arboreus* var. *longifolius*
CC. Leaves unlobed, essentially ovate-lanceolate.
L. Branchlets, petioles or lower leaf-surface very heavily haired, with a dense felt-like or velvet-like pubescence, or with long semi-rigid yellowish hairs.....*3. M. arboreus*
LL. Branchlets, petioles and lower leaf-surface pubescent or glabrous, but pubescence never continuously so dense as to be velvet-like.....
.....(vars. of *M. arboreus)*
M. Involucral lobes broadly lanceolate (at least 3 mm. broad at the base), more or less foliaceous; South America.....
.....*3j. M. arboreus* var. *Williamsii*
MM. Involucral lobes linear or linear-lanceolate to obovate or spatulate (always less than 3 mm. broad at base), never foliaceous.
N. Calyx about twice as long as broad, long-cylindric, with tube manifestly longer than fruit, contracted above fruit and enclosing it; South America.....*3e. M. arboreus* var. *longifolius*
NN. Calyx slightly (less than twice) longer than broad, subturbinate, or short-cylindric with more or less flaring or spreading lobes, tube scarcely longer than fruit.

O. Leaves almost perfectly elliptic, broadest at the middle, with 3 large palmate veins from which lateral veins emerge almost at right angles; Costa Rica.....*3g. M. arboreus* var. *palmanus*

OO. Leaves from linear-lanceolate to ovate-cordate, broadest below the middle, with 3–7 large veins and variable reticulation patterns.

P. Flowers white; central Mexico.....*3d. M. arboreus* var. *Hintoni*

PP. Flowers red.

Q. Leaves narrow, oblong-lanceolate, 2.5–3.5 times as long as broad; pubescence of upper leaf-surface predominantly stellate; petioles short (0.5–3.0 cm.); flowers small (2.0–2.5 cm. long); British Honduras.....*3a. M. arboreus* var. *brihondus*

QQ. Leaves broader than in var. *brihondus,* lanceolate to ovate-cordate; pubescence of upper leaf-surface often predominantly straight-haired; petioles and flowers variable in length, usually longer and larger than in var. *brihondus*

R. Involucral lobes spatulate, broadest above the middle; flowers small (2.0–3.2 cm. long); upper leaf-surface predominantly straight-haired; Vera Cruz and Nuevo Leon, Mexico.....*3i. M. arboreus* var. *sepium*

RR. Involucral lobes usually linear or linear-lanceolate (if spatulate, upper leaf-surface without straight hairs); flowers large or small; pubescence of upper leaf-surface generally predominantly stellate.

S. Flowers more than 4.2 cm. long; robust.....
.....*3h. M. arboreus* var. *penduliflorus*

SS. Flowers 2.3–4.2 cm. long....*3f. M. arboreus* var. *mexicanus*

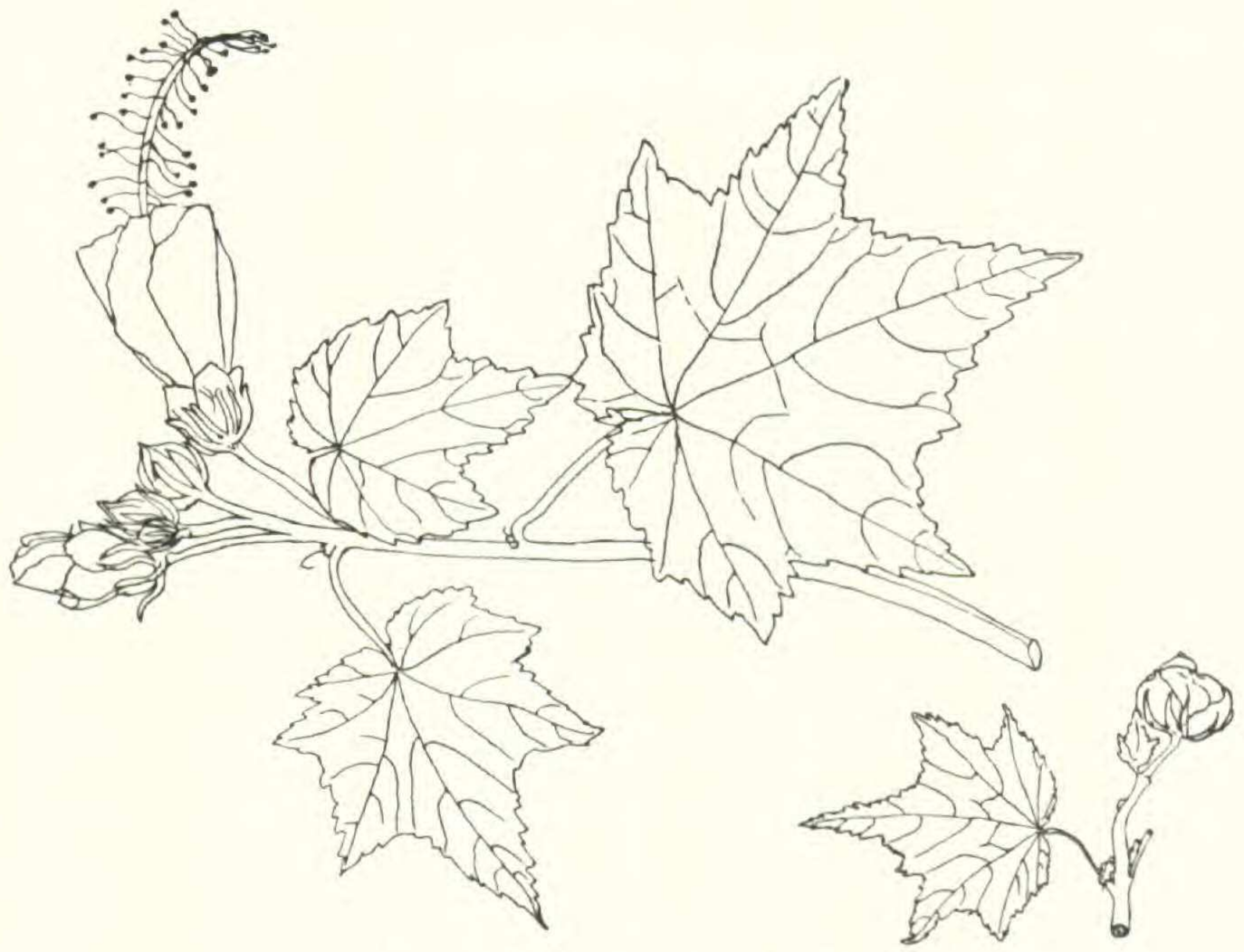
SSS. Flowers less than 2.3 cm. long; chiefly West Indies.....
.....*3b. M. arboreus* var. *cubensis*

1. Malvaviscus candidus DC. Prodr. 1: 445. 1824; Moc. & Sessé ex A. DC. Calcq. des Dess. *pl. 90.* 1874; Standl. in Contr. U. S. Nat. Herb. **23**: 774. 1923.

Malvaviscus Pringlei E. G. Baker ex Robins. & Greenm. in Am. Jour. Sci. III, **50**: 175. 1895; Standl. loc. cit. 774. 1923, in syn.

Shrubs, with upper branches, petioles and pedicels densely stellate-pubescent, the hairs often in clusters. Leaves large, up to 18 cm. broad, densely or thinly stellate-pubescent on lower surface, upper surface predominantly straight-haired; lobes 5, triangular-acute, dentate, often irregularly so, terminal lobe largest, basal pair smallest; veins (5 large palmate veins and many small reticulate ones) conspicuous, especially elevated on lower surface, usually heavily haired; petioles 2–20 cm. long; stipules linear, 5–7 cm. long, caducous. Inflorescence terminal or subterminal, or occasionally flowers solitary towards tip of the leafy branch; flowers large and showy, about 8 cm. long; involucral lobes generally 12, linear or narrowly linear-lanceolate, somewhat shorter than the calyx, pubescent; calyx about 2 cm. long, often inconspicuously ridged longitudinally, lightly

pubescent or subglabrous on the outside, glabrous inside except toward the pannose margins of the ovate-lanceolate calyx-lobes and the lower portion of the calyx-tube which is encrusted with fleshy hairs; corolla white, petals subretuse, lightly pubescent on the outside below the middle, with curled, simple, coarse hairs; receptacle convex; ovary depressed-globose; style usually 12–14 cm. long, curved upward, the style-branches 7–10 mm. long, pubescent; staminal column arcuate, usually 11–13 cm. long, 5-dentate, staminiferous in its upper half; filaments linear, about 1 cm. long, subglabrous; anthers about 2 mm. long. Fruit 1.5 cm. in diameter,



M. candidus, × approx. ⅕.

consisting of 5 brown-black, 1-seeded, ridged carpels which separate at maturity; seed reniform, about 6 mm. long.

Distribution: north-central Mexico (see Map 2).

Specimens examined:

MEXICO: COAHUILA—Saltillo, *Palmer 686* (A, F, G, M, NY, US). GUANAJUATO—Guanajuato, *Duges 281* (G). JALISCO—Colotlan, *Rose 2670* (G, US). QUERETARO—without exact locality, *Agniel 10621* (US). MEXICO—Mexico, *Rose & Hay 6354* (US); Molino, *MacDaniels 526* (F). MICHOACAN—Lake Cuitzeo, *Pringle 4132* (A, F, G, M, NY, US).

This species is very distinct from *Malvaviscus arboreus* and its varieties, being easily recognized by the large white flowers with up-curving staminal column and long filaments. Also the nearly star-shaped leaf is seldom found in *M. arboreus*.

It cannot be said that plate 90 of deCandolle's 'Calcques des Dessins de Mociño & Sessé's Flore des Mexique' is undeniably *Malva-*

viscus. The illustration, in some respects, rather indicates another genus, possibly *Hibiscus*. For example, only 5 style-branches are shown, the involucre or subcalyx appears almost foliaceous, the fruit somewhat capsule-like, and the seed is not reniform. Yet the whole set of Mociño & Sessé illustrations seems to a degree inaccurate as regards details, and it appears better to regard the above-mentioned characters as craftmanship inaccuracies rather than to consider the species name *candidus* as a "nomen dubium." This seems desirable, as in general appearance the Mociño & Sessé illustration could scarcely fit any other plant, having convolute corollas, auriculate petals, curved staminal column, etc., characters manifest in Baker's later-proposed type, *Malvaviscus Pringlei*.

2. **Malvaviscus palmatus** Ulbrich, in Verhandl. Bot. Ver. Prov. Brandenburg **50**: 89, *fig. 1.* 1908.

Since a specimen of this species (known only from the type) is not at present available for examination, the following free translation of Ulbrich's original description is given:

Glabrous shrub 3 m. high, with terete, striate branches and long-petiolate palmate leaves; stipules caducous; leaves 7-nerved, palmately dissected, deeply cordate, glabrous, paler beneath and very sparsely pubescent with simple and 3-rayed stellate hairs, 7-lobed, lobes lanceolate, usually caudate-subacuminate, repand, 5–10 cm. long, 1.5–2.0 cm. wide, cinereous-green, also puncticulate and pubescent with small adpressed hairs; petiole up to 15 cm. long; inflorescence axillary, subumbellate-racemose, with several short-petiolate palmately dissected leaves; flowers very large, with pedicels 1–2 cm. long; involucre 15–20 mm. long, 9-lobed, lobes linear-lanceolate, 12–15 mm. long, 1.5 mm. wide, acute, fringed with subrigid yellow hairs, after anthesis somewhat accrescent; calyx cylindric-campanulate, 18–20 mm. long, 5-lobed, nerves and margins fringed with small, crisp, rigid hairs; calyx-lobes deltoid-subacuminate, 5 mm. long; petals dark red, obovate-cuneate, obtuse, about 4 cm. long, about 22 mm. broad at the broadest part, unguiculate, ciliate with minute, crisp hairs, above sparingly and below densely pubescent with coarse, 3-rayed and fine simple hairs; staminal tube 6 cm. long or longer, tenuous, barely 1 mm. in diameter, apically with 5 acute lobes each 1 mm. long, 2 mm. from the top bearing stamens for 8 mm. of its length; filaments delicate, 1.5 mm. long; style exceeding the staminal tube only about 2 mm., 9-parted into subliguliform style branches each about 3 mm. long; stigmas sub-

capitellate; stigma, style and staminal tube dark violet; fruit subglobose, black, baccate, glabrous, about 10 mm. in diameter; carpels prominently nerved on the outside, subangulate, 1-seeded; seed subreniform, 6 mm. long, 2–3 mm. wide, glabrous, fuscous.

Distribution: Brazil (see Map 3).

Specimens examined: none available.

If the description and figure presented by Ulbrich are entirely accurate, *Malvaviscus palmatus* is indeed unlike any other *Malvaviscus* known. So distinctive are the deeply lobed palmate leaves that this species could not be confused with any other in the genus. From description only, it is difficult to say with surety that this species may not belong in the genus *Pavonia;* yet Ulbrich's description of the fruit and his excellent illustration of the type specimen indicate that this plant probably is a *Malvaviscus*. On the other hand, the original description does not state that the petals are auriculate, from which the inference is that the plant may be *Pavonia*. Certainty of identification will have to await examination of the type or some authentic specimen; meanwhile the species had best remain as *Malvaviscus palmatus*.

3. Malvaviscus arboreus Cav. Tert. Diss. Bot. 131, *pl. 48, fig. 1.* 1787; HBK. Nov. Gen. & Sp. **5**: 287. 1821 [1822]; DC. Prodr. **1**: 445. 1824; G. Don, Gen. Hist. Dichlamyd. Pl. **1**: 475. 1831; Spach, Hist. Nat. Veg. Phan. **3**: 369. 1834; Schlecht. in Linnaea **11**: 359. 1837; E. G. Baker in Jour. Bot. **37**: 344. 1899; Standl. in Contr. U. S. Nat. Herb. **23**: 775. 1923.

Hibiscus Malvaviscus L. Sp. Pl. **2**: 694. 1753.

Achania Malvaviscus (L.) Sw. Prodr. Veg. Ind. Occ. 102. 1788; Ait. Hort. Kew. **2**: 459. 1789 (possibly var. *mexicanus).*

Achania pilosa Sw. loc. cit. 102. 1788; ?Ait. loc. cit. 459. 1789; Sw. Fl. Ind. Occ. **2**: 1224. 1800; Lodd. Bot. Cab. *pl. 829.* 1817? (possibly var. *mexicanus* or *cubensis,* but better not to be used as name-bringing synonym for either variety because of uncertainty of synonymy).

Achania mollis Ait., loc. cit. 459. 1789.

Achania coccinea Salisb. Prodr. 385. 1796.

Malvaviscus cordifolius Moench, Meth. Suppl. 208. 1802.

Malvaviscus acapulcensis HBK. Nov. Gen. & Sp. **5**: 286. 1821 [1822].

Malvaviscus concinnus HBK. loc. cit. 286. 1822.

Malvaviscus Balbisii DC. Prodr. **1**: 445. 1824.

Malvaviscus cordatus Balb. ex DC. loc. cit. 445. 1824, nomen nudum, in synon.

Malvaviscus mollis DC. loc. cit. 445. 1824; Mart. Fl. Bras. **12**[3]: 538. *pl. 106.* 1892.

Malvaviscus pilosus DC. loc. cit. 445. 1824; Macfad. Fl. Jam. **1**: 64. 1837.

Achania concinna (Kth.) Spreng. in L. Syst. Veg. ed. 16, **3**: 100. 1826.

Malvaviscus acerifolius Presl, Reliq. Haenk. **2**: 135. 1835; Standl. in Contr. U. S. Nat. Herb. **23**: 775. 1923.

Hibiscus racemosus Willd. ex Steud. Nom. Bot. ed. 2, **1**: 760. 1841.

Malvaviscus spathulatus Garcke in Otto & Dietr. Allg. Gartenz. **21**: 321. 1853.

Malvaviscus velutinus Triana & Planch. in Ann. Sci. Nat. Bot. IV, **17**: 168. 1862; Mart. loc. cit. 1892, in synon.

Malvaviscus speciosus Lind. & Planch. ex Mart. loc. cit. 1892.

Malvaviscus arboreus var. *pilosus* Hitchc. in Ann. Rept. Mo. Bot. Gard. **4**: 64. 1893.

Malvaviscus arboreus var. *parviflorus* E. G. Baker in Jour. Bot. **37**: 345. 1899.

Malvaviscus Malvaviscus (L.) Millsp. in Pub. Field Mus. Bot. **2**: 73. 1900.

Malvaviscus Cutteri Standl. in Pub. Field Mus. Bot. **4**: 315. 1929.

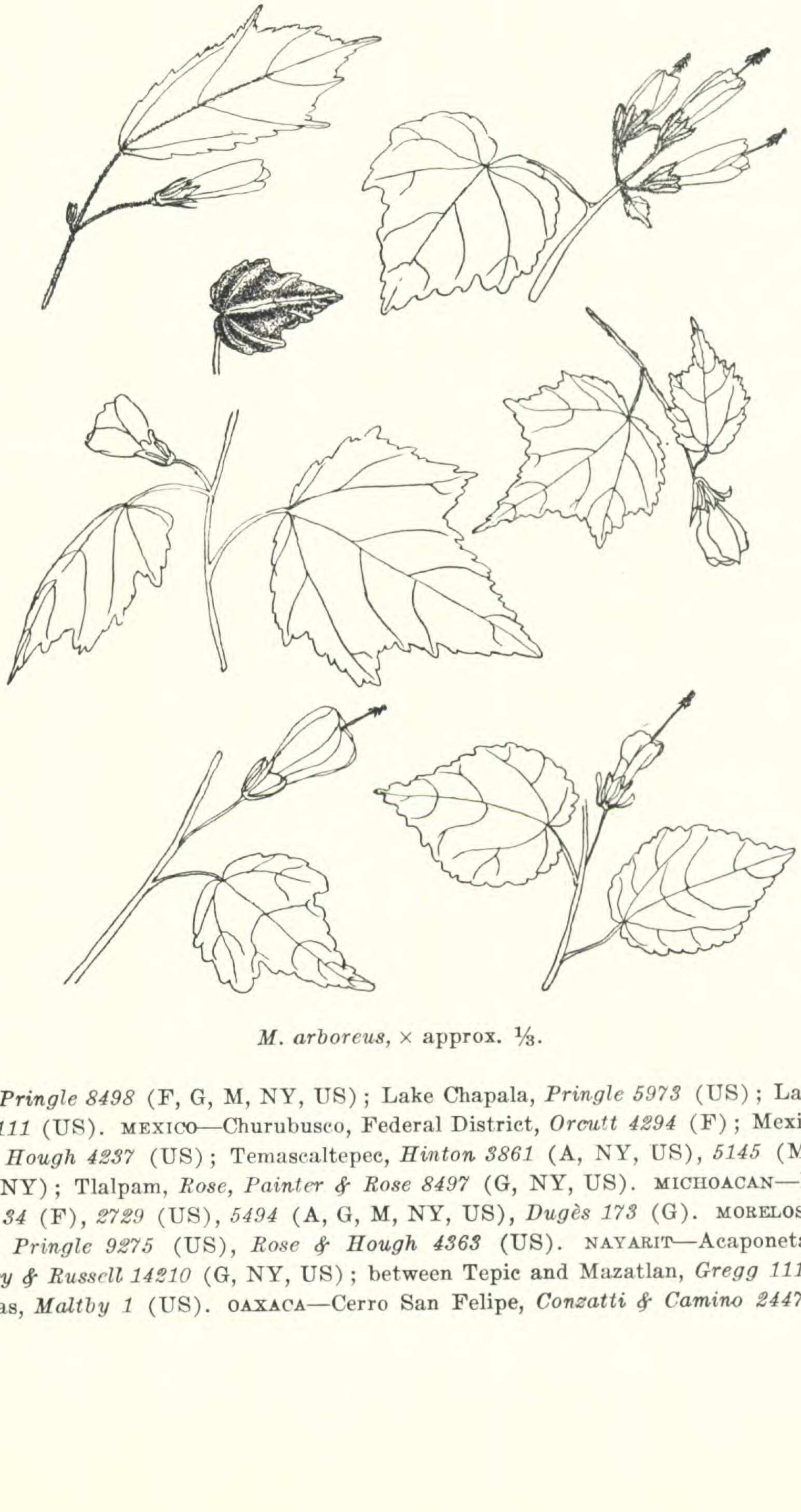
Shrub or vine-like plants with branchlets, petioles and pedicels densely velvety-pubescent (rarely almost glabrous), pubescence shorter and rougher in plants of certain subxerophytic regions. Leaves petiolate, variously lobed to entire, densely stellate-pubescent on lower surface, lightly to densely pubescent on upper surface, coarsely serrate to sinuate on the margins. Flowers 2.8–5.5 cm. long. Involucre usually densely pubescent, with 6 or more linear, linear-lanceolate or spatulate lobes approaching or exceeding the calyx in length. Calyx variously pubescent, generally with 5 subdeltoid lobes. Corolla red, of 5 generally deeply retuse petals. Mature staminal column usually exserted $\frac{1}{3}$–$\frac{1}{4}$ of its length.

Distribution: Mexico to Peru and Brazil; occasional in West Indies (see Map 1).

Specimens examined:

MEXICO: CAMPECHE—Carasayal, *Goldman 461* (US); Champoton, *Steere 1924* (F); Tuxpena, *Lundell 970* (A, F, M, NY, US). CHIAPAS—Comitan, *Goldman 904* (US);

Escuintla, *Matuda 95* (US); Huehuetan, *Nelson 3835* (US); Ocuilapa, *Nelson 3005* (G, US); San Vicente, *Goldman 864* (US); Teopisca, *Nelson 3454* (G, US), *Goldman 940, 983* (US); without definite locality, *Ghiesbreght 642* (G, M). DURANGO—Tamazula, *Gentry 5258* (G, NY). HIDALGO—Dublan, *Rose & Hay 5302* (US); Jacala, *Chase 7073* (F, G, M, NY), *Edwards 818* (F), *Lyonnet 1298, 1323* (US); Tula valley, *Pringle 8232* (A, F, G, M, NY, US), *9455* (G, US), *9688* (F G, M, NY, US). JALISCO—Barranca de Oblatos, *Barnes & Land 203* (F, US); Etzatlan, *Rose & Painter 7541* (G, US); Guadalajara, *Pringle 8498* (F, G, M, NY, US); Lake Chapala, *Pringle 5973* (US); La Palma, *R.E.J. 111* (US). MEXICO—Churubusco, Federal District, *Orcutt 4294* (F); Mexico City, *Rose & Hough 4237* (US); Temascaltepec, *Hinton 3861* (A, NY, US), *5145* (M), *7184* (A, F, NY); Tlalpam, *Rose, Painter & Rose 8497* (G, NY, US). MICHOACAN—Morelia, *Arsène 34* (F), *2729* (US), *5494* (A, G, M, NY, US), *Dugès 173* (G). MORELOS—Cuernavaca, *Pringle 9275* (US), *Rose & Hough 4363* (US). NAYARIT—Acaponeta, *Rose, Standley & Russell 14210* (G, NY, US); between Tepic and Mazatlan, *Gregg 1110* (M); San Blas, *Maltby 1* (US). OAXACA—Cerro San Felipe, *Conzatti & Camino 2447* (US);



M. arboreus, × approx. ⅓.

Oaxaca, *Conzatti & Gonzalez 27* (M, US); Sierra de San Felipe, *Pringle 5609* (G, US). SAN LUIS POTOSI—Tamazunchale, *Kenoyer A373* (F). SINALOA—Coacoyolitos, *Ortega 6444* (G, US); Escuinapa, *Ortega 5183* (US), *6114* (A, G); Mazatlan, *Rose, Standley & Russell 14096* (G, NY, US); Villa Union, *Lamb 399* (G, M, NY, US), *Rose, Standley & Russell 13939* (NY, US). TAMAULIPAS—Chamal Hda., *Wooton* (US); Tampico, *Kenoyer 772a* (F). VERA CRUZ—Fortuno, *Williams 8977* (F); Juana Ramirez, *Palmer 470* (US); Rinconada, *Schery 204, 206* (M). YUCATAN—Chichankanab, *Gaumer & sons 23686* (F, G, NY, US); Uxmal, *Schott 643* (F), *Steere 2020* (F).

GUATEMALA: CHIMALTENANGO—Chimaltenango, *Standley 79935* (F, US); Patzum, *Standley 61483* (A, F); Tecpam, *Skutch 541* (A, F, NY, US). CHIQUIMULA—Amatillo, *Steyermark 30505* (F); Chiquimula, *Steyermark 30615* (F); Ipala, *Steyermark 30360* (F). HUEHUETENANGO—Huehuetenango, *Holway 766* (US), *Standley 81929* (F, M); Quen Santo, *C. & E. Seler 2681* (A, G, US); San Miguel Acatan, *Skutch 1021* (A, F, NY). JALAPA—Jalapa, *Steyermark 32851* (F). JUTIAPA—Asuncion Mita, *Steyermark 31959* (F); Jutiapa, *Standley 75248* (F, M). PETEN—Tikal, *Cook & Martin 63* (G, US), *197* (US). QUEZALTENANGO—Zunil, *Steyermark 34989* (F). QUICHE—San Miguel Uspantan, *Heyde & Lux 2920* (G, M, NY, US); WITHOUT DEFINITE LOCALITY—*Heyde 193a* (US). SACATEPEQUEZ—Antigua, *Standley 61127* (F); Duenas, *Standley 63263* (F); Santa Lucia, *Popenoe 690* (US); Santiago, *Gomez 822* (US); Volcan Acatenango, *Kellerman 4819* (US). SAN MARCOS—Chamac, *Standley 66190* (F); Tajumulco, *Steyermark 36553* (F). SANTA ROSA—Malpais, *Heyde & Lux 6071* (G, US). SOLOLA—Primavera, *Shannon 419* (US). ZACAPA—Zacapa, *Pittier 1749* (NY, US). DEPT. IN DOUBT—near Jacaltenanjo, *Nelson 3563* (US).

HONDURAS: ATLANTIDA—Tela, *Standley 52756, 54127* (A, F, US). COMAYAGUA—El Achote, *Yuncker, Dawson & Youse 5879* (F, G, M), *5880* (F), *6239* (F, G, M, NY). SANTA BARBARA—San Pedro Sula, *Thieme 5168* (US).

SALVADOR: SAN MIGUEL—Laguna de Olomega, *Standley 21021* (G, US). SAN SALVADOR—San Salvador, *Calderon 121* (F, G, M, NY, US), *Standley 22690* (G, NY, US); Volcan de San Salvador, *Standley 22975* (G, NY, US). SAN VICENTE—San Vicente, *Standley 21402* (G, US). WITHOUT DEFINITE LOCALITY—*Renson 8* (US).

NICARAGUA: MANAGUA—Managua, *Artemio 72* (US), *Chaves 75* (US), *Garnier 291* (US), *Greenman 5665, 5712* (M), *Maxon, Harvey & Valentine 7275, 7353* (US), *7450* (NY, US); Momotombo, *Smith 118* (G, M, US). RIVAS—San Juan del Sur. *West 3552* (G, M).

COSTA RICA: ALAJUELA—Carrillos de Poas, *Brenes 19308* (F); San Ramon, *Brenes 17050, 21480, 21917* (F), *Tonduz 17654* (US). CARTAGO—Cartago, *Biolley 8977* (US), *Cooper 54* (F), *Standley 33368* (US); Copey forest, *Tonduz 11693* (F, US). SAN JOSE—Cerro de Escaso, *Solis 266* (F); San Jose, *Valerio 220* (F); Santa Maria de Dota, *Standley 42268* (US), *Tonduz 11631* (US). PROV. IN DOUBT—between Santiago and Picacho Mondongo, *Brenes 16967* (F); exact locality unknown, *Worthen* (M), *Valerio 67* (US).

WEST INDIES: BARBADOS—Lodge Hill, St. Michael, *Botanic Station 508* (NY, US). CUBA—Havana Botanical Garden, *Britton & Wilson 511* (NY), *Curtiss 726* (A, F, G, M, NY, US); Havana, *Leon 695* (NY); Olimpo Finca, *Hioram 3976* (NY); Oriente, *Ekman 10069* (NY); Santiago de las Vegas, *Baker 7* (A, G, M, NY, US). JAMAICA—Mount Pleasant, *Harris 11143* (F, NY, US); St. Andrew, *Harris 11835* (F, G, M, NY, US). VIRGIN ISLANDS—St. Thomas, *Northrop 3* (NY).

COLOMBIA: CUNDINAMARCA—Bogotá, *Triana 388, 3132* (US); El Colegio, *Aristé-Joseph 1060* (A, F, US); El Paso, *Arbelaez & Cuatrecasas 6565* (US); Girardot, *Rusby & Pennell 143* (NY), *170* (NY, US); Ubague, *Aristé-Joseph* (US). SANTANDER—Las Vegas, *Killip & Smith 16087* (G, US). SANTANDER DEL NORTE—Tapata, *Killip & Smith 20179* (G, US). TOLIMA—Honda, *Aristé-Joseph A975, s.n.* (US), *Holton 748* (G, NY).

VENEZUELA: DISTRITO FEDERAL—Caracas, *Pittier 7121* (G, NY, US), *11116* (A, G,

NY, US). MÉRIDA—Tabay, *Gehriger 565* (F, US). MIRANDA—San Diego de los Altos, *Pittier 13014* (A, F, NY, US).

ECUADOR: CHIMBORAZO—Huigra, *Rose 22595* (US).

PERU: JUNIN—Chanchamayo Valley, *Schunke 21, 1492* (F); Juaja, *Univ. of Lima 13* (L); San Ramon, *Killip & Smith 24714* (F, NY, US), *Schunke A116* (F, US). LIMA—*Univ. of Lima 75* (L). LORETO—Balsapuerto, *Klug 3015* (A, F, G, M, US).

BRAZIL: AMAZONAS—mouth of Rio Embira, *Krukoff 5150* (A, F, NY, US).

This species shows an "influence" possibly derived from a cross with *M. candidus* in west-central Mexico some time ago and other later crosses with many varieties from Texas to South America. Thus it is a catch-all species for specimens approaching all the

M. arboreus var. *brihondus* × approx. ⅓.

M. arboreus var. *cubensis* × approx. ⅓.

varieties but differing in some way due to what may be termed the "candidus influence." This "candidus influence" may be manifest in either or both of two ways: (1) dense velvety pubescence of petioles, pedicels, upper branches, and lower leaf surface, or (2) distinctive lobation of the leaf towards the *M. candidus* type.

3a. Malvaviscus arboreus var. **brihondus**[23] Schery, n. var.

Shrub, upper branches pubescent, often scantily so, with appressed-stellate or straight hairs. Leaves oblong-lanceolate, 2.5–3.5 times as long as broad, unlobed, bluntly dentate to sinuate, sparsely pubescent on lower surface with large stellate hairs, upper surface with small appressed stellate hairs predominating over

[23] Frutex foliis oblongo-lanceolatis stellato-pubescentibus 2.5–3.5 plo longioribus quam latioribus; petiolis brevibus, 0.5–3.0 cm. longis; floribus parvis, 2.0–2.5 cm. longis.

straight hairs; petioles short, 0.5–3.0 cm., usually finely pubescent. Flowers very small, 2.0–2.5 cm. long. Involucral lobes usually wider toward the apex than toward the base. Mature staminal column exserted about half its length.

Distribution: British Honduras (see Map 2).

Specimens examined:
BRITISH HONDURAS: All Pines, *Schipp 708* (A, F, G, M, NY); Belize, *Lundell 4246* (F); Belize River, *Record* (G, US); El Cayo, *Gentle 2373* (A); Honey Camp, *Lundell 13, 52* (F), *480* (F, M TYPE, US), *Meyer 163* (F); Prospecto, *Gentle 870* (A, F, M, NY); Tower Hill Estate, *Karling 43* (F, US).

Distinguishing features of this variety are the small flower and the long, relatively narrow leaf which is generally short-petiolate and rounded at the base.

3b. Malvaviscus arboreus var. **cubensis** Schlecht. in Linnaea **11**: 360. 1837.

Malvaviscus Jordan-Mottii Millsp. in Field Col. Mus. Bot. **2**: 73. 1900.

Malvaviscus Cokeri Britton ex Coker in Shattuck, Bahama Isl. 259. 1905.

Woody shrub-like plants with upper branches, pedicels and petioles subglabrous or pubescent, usually with long (1.0–1.5 mm.) hairs. Leaves lanceolate to ovate-lanceolate, cordate or subcordate at the base, bluntly dentate to sinuate-margined, hairs preponderantly stellate on both upper and lower leaf-surfaces. Flowers very small, less than 2.3 cm. long. Involucral lobes linear or sublinear, densely or lightly pubescent. Mature staminal column exserted ½ to ⅓ its length.

Distribution: West Indies and occasional near the Yucatan Peninsula (see Map 2).

Specimens examined:
MEXICO: OAXACA—Tuxtepec, *Nelson 363* (US).
GUATEMALA: SACATEPEQUEZ—Acatenango, *Kellerman 4990* (US).
WEST INDIES: BAHAMA ISLANDS—Abaco: *Brace 1527* (A, F, US). Great Bahama: *Brace 3541* (F), *Britton & Millspaugh 2442* (F, G, US). Cayman Brac: The Creek, *Millspaugh 1166* (F). CUBA—Camarioca, *Britton & Wilson 14032* (NY, US); Cerro de Esperon, *Killip 13511* (US); Corrientes Bay, *Britton & Cowell 9902* (G, US); Guanajay, *Baker & Van Hermann 4253* (NY), *Palmer & Riley 697* (NY); San Juan Valley, *Roig 3160* (NY); without exact locality, *Wright 2064* (G, M). GRAND CAYMAN—Spot Bay, *Millspaugh 1313* (F); without exact locality, *Hitchcock* (F, M), *Rothrock 180, 237* (F). ISLE OF PINES—Boqueron, *Britton, Wilson & Selby 14498* (US). JAMAICA—Porus, *Lloyd 1108* (F, M); without exact locality, *Hart* (F).

This variety is close to var. *brihondus* from which it can be distinguished most easily by the broader, generally cordate leaf. It is distinguished from var. *mexicanus* and other varieties by the very small flowers.

3c. Malvaviscus arboreus var. **Drummondii** (Torr. & Gray) Schery, n. comb.

M. arboreus var. *Drummondii*, × approx. ⅓.

Malvaviscus Drummondii Torr. & Gray, Fl. N. Am. **1**: 230. 1838; Eaton & Wright, N. Am. Bot. 314. 1840; Engelm. & Gray in Boston Jour. Nat. Hist. (Pl. Lindh.) **5**: 6. 1845; Gray, Gen. Pl. U. S. **2**: 78, *pl. 131.* 1849; Gray in Smithson. Contr. to Knowledge (Pl. Wright.) **3**: 22. 1852; Torrey, Bot. Mex. Bound. Surv. 40 1856; Wood, Classbook Bot. 269. 1865; Coulter in Contr. U. S. Nat. Herb. (Bot. W. Texas) **2**: 43. 1891; Standl. in Contr. U. S. Nat. Herb. **23**: 774.

1923; Small in Addisonia **15**: 19, *pl. 490.* 1930; Man. Southeast. Fl. 854. 1933.

Pavonia Drummondii Torr. & Gray, Fl. N. Am. **1**: 682. 1840, fide S. Wats. loc. cit. 139. 1878; Walp. Rep. **1**: 298. 1842; Dietr. Syn. Pl. **4**: 824. 1847; Gray, Gen. Pl. U. S. **2**: 76. 1849.

Hibiscus Drummondii Young, Fl. Texas, 186. 1873, fide S. Wats. Bibl. Ind. 139. 1878.

Procumbent, clambering or erect shrub; stems glabrous toward the base, densely and minutely tomentose apically, with tomentum uniform, of stellate or substellate hairs. Leaves cordate at base, as broad as long, shortly 3-lobed, bluntly dentate, usually with 5 prominent palmate veins, lower surface with many small stellate hairs and less abundant larger ones, upper surface predominantly straight-haired. Flowers small, usually 2.5–3.0 cm. long. Involucral lobes oblanceolate, widest above the middle, obtuse or acute apically. Mature staminal column exserted ½–¼ its length.

Distribution: Gulf states of the United States; eastern Mexico; evidently introduced into Cuba (see Map 2).

Specimens examined:

UNITED STATES: FLORIDA—Duval Co.: Jacksonville, *Curtiss* (G); Escambia Co.: Pensacola, *McCormick* (G); Hillsborough Co.: without exact locality, *Fredholm 6413* (G); Leon Co.: Tallahassee, *Berg* (NY). LOUISIANA—without exact locality, *Chapman* (NY). MISSISSIPPI—Adams Co.: Natchez, *Gale* (NY). TEXAS—Bexar Co.: Bracken, *Groth 209* (F, G, US); San Antonio, *Bush 1211* (M, NY, US), *Clemens 610* (M), *Dewey* (US), *Eggert* (M), *Havard* (US), *Heller 1833* (G, M, NY, US), *Jermy 191* (M), *271* (US), (M), *Metz* (NY), *Palmer 115* (G, M, US), *Reverchon 1197* (F, M, US), (F), *255518* (M), *Thurber* (G), *Ward* (US), *Wilkinson 47* (M), *102* (M, NY); Brazoria Co.: Brazoria, *Fisher 125* (US); Sandy Point, *Fisher 191* (US); Brazos Co.: College Station, *Palmer 10756* (M, US); Burnet Co.: Marble Falls, *Biltmore Herb. 11079a, 11079b* (US); Caldwell Co.: Columbia, *Bush 312* (M, NY); Cameron Co.: Brownsville, *Barber 23* (US), *Ferris & Duncan 3150* (M), *Pringle 1959* (F, G, M, NY, US), *Runyon* (M), *Townsend 49* (F, US), *Sargent* (A); Chambers Co.: Anahuac, *Hanson 2* (US); Comal Co.: New Braunfels, *Biltmore Herb. 11079e* (US), *Lindheimer 25* (F, G, M, US), *685* (F, G, M, NY, US), (M); Dallas Co.: Dallas, *Reverchon 1195* (F, US); Falls Co.: Gurley, *Howell 247* (US); Gillespie Co.: Fredericksburg, *Jermy 707* (M); Goliad Co.: Goliad, *Williams 70* (F, M); Harris Co.: Hockley, *Thurrow* (F); Houston, *Buckley* (M), *Hall 53* (F, G), *Mohr* (US), *Palmer 8584* (M, NY, US), *Ward* (US); Sheldon, *Reverchon 3827* (M); Hays Co.: San Marcos, *Trelease* (M), *Tharp* (NY); Jackson Co: Horseshoe Lake, without collector's name (M); Navidad River, *Drushel 2844* (M); Kendall Co.: Spanish Pass, *Clemens 609* (M, NY). Madison Co.: Trinity River, *Dixon 441* (F, G, NY); Montgomery Co.: Willis, *Warner* (M); Travis Co.: Austin, *Biltmore Herb. 11079c, 11079d* (US), *Letterman 66* (M, NY), *102* (M, US), *Bogusch 115* (A); Victoria Co.: Victoria, *Clark 3977* (M); Wharton Co.: Pierce, *Tracy 7476* (F, G, M, NY, US); Wharton, *Palmer 6609* (M, US); Williamson Co.: Round Rock, *Bodin 129* (US).

MEXICO: SAN LUIS POTOSI—Canoas, *Rose & Hough 4883* (US); Tancanhuitz, *Nelson*

4392 (US). TAMAULIPAS—El Milagro, *Bartlett 11069* (F, US); San Jose, *LeSueur 283* (F); Tampico, *Palmer 94* (G, M, NY, US), *387* (US), *525* (G, US).

WEST INDIES: CUBA—without exact locality, *Wright 2065* (M), *2068* (G, M, NY, US).

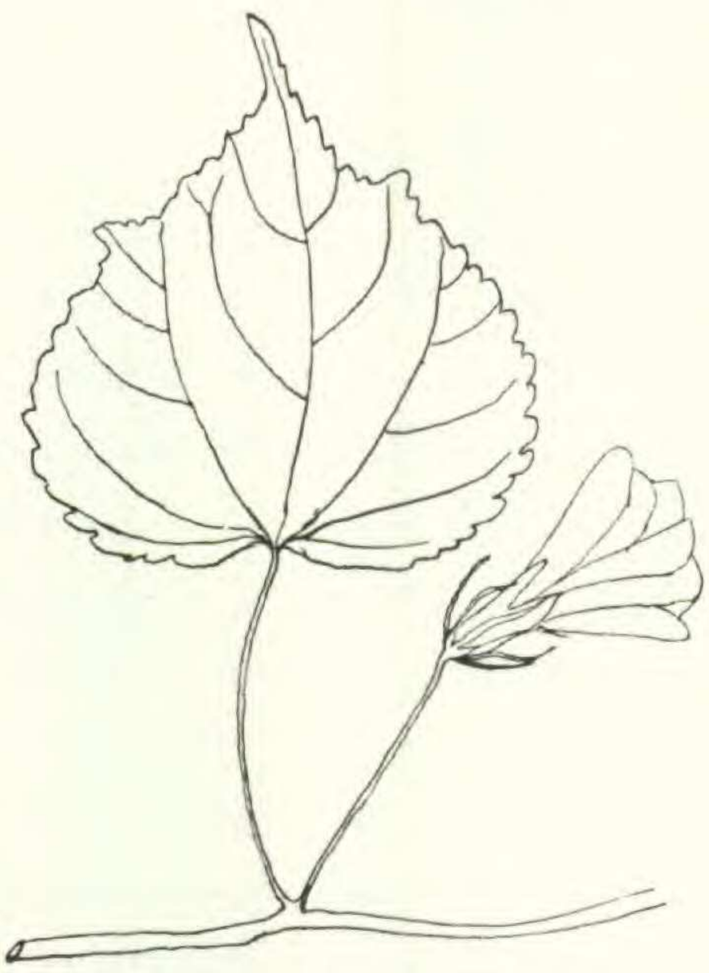
This is one of the most distinct varieties of *M. arboreus*. It is best distinguished by a combination of characters including the broad, cordate, obtusely lobed leaf; predominance of straight hairs on the upper leaf surface; and involucral lobes which are broadest above the middle.

3d. Malvaviscus arboreus var. **Hintoni** (Bullock) Schery, n. comb.

Malvaviscus Hintoni Bullock in Kew Bull. 291. 1937.

Shrub with upper branches, pedicels and petioles pubescent with long hairs (usually 1.0–1.5 mm. long). Leaves lanceolate, 2–3 times

M. arboreus var. *Hintoni*
× approx. ⅓.



M. arboreus var. *longifolius*
× approx. ⅓.

as long as broad, sometimes obscurely 3-lobed, rounded at base, bluntly serrate, lightly pubescent, lower surface with large stellate hairs, upper surface with smaller stellate and straight hairs. Flowers 3.5–5.0 cm. long, white or whitish. Involucral lobes linear or linear-spatulate. Mature staminal column exserted ⅓–¼ its length.

Distribution: east-central states of Mexico (see Map 2).

Specimens examined:

MEXICO: MEXICO—Temascaltepec, *Hinton 690* (F), *3928* (A, NY), *4289* (A, F, NY), *5057* (A, M, NY), *5371* (A, NY), *7912* (US). VERA CRUZ—Chontla, *Cardenas 375* (A, F).

This variety is very close to marginal types of *M. arboreus* and *M. arboreus* var. *mexicanus* but can be distinguished by the white

flowers (all other varieties have red flowers) and comparatively narrow lanceolate leaves.

3e. Malvaviscus arboreus var. **longifolius** (Garcke) Schery, n. comb.

Malvaviscus longifolius Garcke in Otto & Dietr. Allg. Gartenz. **22**: 321. 1854.

Malvaviscus cuspidatus Turcz. in Bull. Soc. Nat. Mosc. **31**: 190. 1858.

Malvaviscus leucocarpus Planch. & Linden ex Triana & Planch. in Ann. Sci. Nat. Bot., IV, **17**: 169. 1862; Mart. Fl. Bras. **12**^{3}: 536. 1892.

Malvaviscus Funkeanus Linden & Planch. Trois Voy. Linden in Pl. Columb. **1**: 41. 1863.

Malvaviscus elegans Linden & Planch. ex Mart. loc. cit. 537. 1892.

Malvaviscus maynensis Huber in Bol. Mus. Goeldi **4**: 583. 1906.

Malvaviscus integrifolius Ulbrich in Verhandl. Bot. Ver. Brandenburg **50**: 88. *fig. 2.* 1908.

Malvaviscus Ulei Ulbrich in Notizblatt **6**: 328. 1915.

Shrub-like plants with upper branches, pedicels and petioles usually with long (1.0–1.5 mm.) hairs, or glabrous. Mature leaves generally large (seldom less than 8 cm. long), ovate-lanceolate to triangular, usually cordate at the base, bluntly dentate or sinuate margined, entire or slightly lobed, upper surface variously pubescent, lower surface stellate-pubescent. Flowers large, usually longer than 4 cm. Involucral lobes linear or linear-lanceolate, usually narrow to acuminate-attenuate. Calyx long-cylindric, usually twice as long as broad or longer, often yellow-setose, contracted above and enclosing the fruit. Mature staminal column exserted ⅓–⅙ its length.

Distribution: northern South America (see Map 3).

Specimens examined:

COLOMBIA: ANTIOQUIA—Angostura?, *André K862* (F, G, NY). ATLANTICO—Barranquilla, *Elias 428* (US); Usiacuri, *Dugand 887* (F). BOLIVAR—Cartagena, *Heriberto 244* (US). WITHOUT EXACT LOCALITY—*Mutis 2262* (US).

VENEZUELA: DISTRITO FEDERAL—Caracas, *Allart 76* (NY, US); Cerro Avila, *Vogl. 76* (F); Los Flores a Papelon, *Delgado 271* (F, US), *Tamayo 385* (US). LARA—Barquisimeta, *Saer 65* (US). MÉRIDA—Tovar, *Fendler 101* (G, M).

ECUADOR: ORO—Santa Rosa, *Hitchcock 21141* (NY, US).

PERU: AYACUCHO—Estrella, *Killip & Smith 23065* (F, G, NY, US). JUNIN—Puerto Bermudez, *Killip & Smith 26648* (NY, US). LORETO—Iquitos, *Williams 8068* (F); La Victoria, *Williams 2675* (F); Rio Nanay, *Williams 508* (F). SAN MARTIN—Juan Jui, *Klug 3919* (F, G, M, NY, US), *4382* (A, F, M, NY, US).

BRAZIL: AMAZONAS—Manariao, *Krukoff 4589* (A, F, M, NY, US); Seringal (Rio Acre), *Ule 9591* (US).

This variety approaches *M. arboreus* and *M. arboreus* var. *penduliflorus*, on the one hand, and *M. arboreus* var. *Williamsii*, on the other. It can best be distinguished by the very long-cylindric calyx enclosing the fruit, the linear or linear-lanceolate involucral lobes, and the relatively large, broad leaves.

3f. Malvaviscus arboreus var. **mexicanus** Schlecht. in Linnaea **11**: 359. 1837, as *Mexicana;* E. G. Baker in Jour. Bot. **37**: 346. 1899.

Pavonia spiralis Cav. Ic. **5**: 20, *pl. 434.* 1799.

Malvaviscus grandiflorus HBK. Nov. Gen. & Sp. **5**: 286. 1821 [1822]; Standl. in Contr. U. S. Nat. Herb. **23**: 775. 1923.

Malvaviscus ciliatus DC. Prodr. **1**: 445. 1824.

Malvaviscus pentacarpus Moc. & Sessé ex. DC. loc. cit. 1824; ex. A. DC. Calq. des Dess. *pl. 88.* 1874.

Achania ciliata Spreng. Syst. Veg. **3**: 100. 1826.

Malvaviscus brevipes Benth. Bot. Voy. Sulph. 68. 1844.

Malvaviscus pulvinatus A. Rich. Bot.—Pl. Vasc., in Sagra, Hist. Nat. Cuba, 133. 1845 (?).

Malvaviscus Sagraeanus, A. Rich. loc. cit. 131, *pl. 14.* 1845(?).

Malvaviscus Guerkeanus Hieron. in Engl. Bot. Jahrb. **21**: 320. 1895.

Malvaviscus arboreus var. *Grisebachii* E. G. Baker in Jour. Bot. **37**: 345. 1899.

Malvaviscus arboreus var. *Sagraeanus* (Rich.) Baker, loc. cit. 1899.

Malvaviscus arboreus var. *Sloanei* Baker, loc. cit. 1899.

Malvaviscus brevibracteatus Baker, loc. cit. 347. 1899.

Malvaviscus Polakowskyi Baker, loc. cit. 346. 1899.

Malvaviscus rivularis Brandg. in Zoe **5**: 211. 1905; Standl. in Contr. U. S. Nat. Herb. **23**: 774. 1923.

Malvaviscus oaxacanus Standl. loc. cit. 775. 1923.

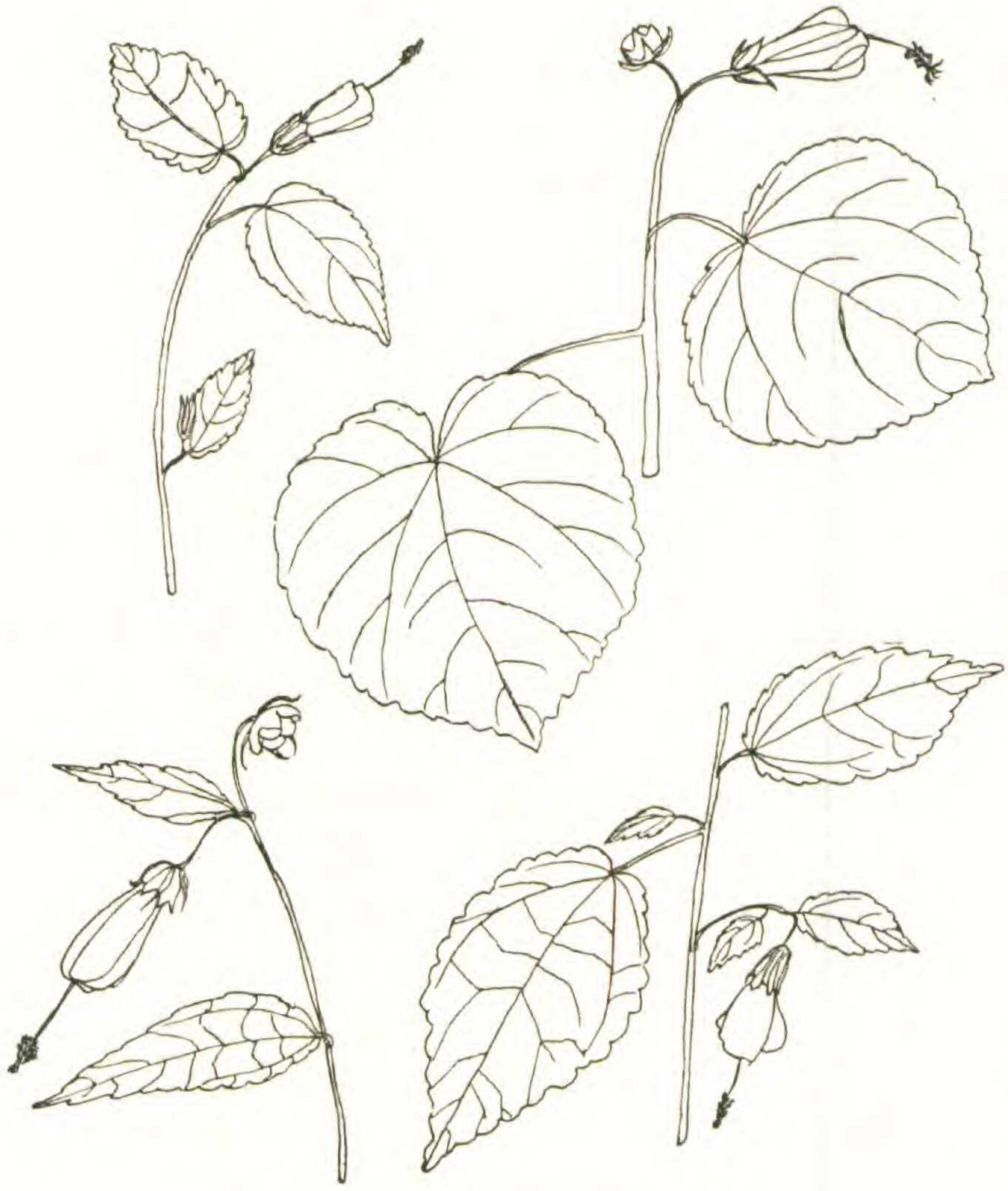
Bushy or vine-like shrubs, with upper branches, pedicels, and petioles variously pubescent or subglabrous. Leaves lanceolate or ovate-lanceolate, rounded or cordate at base, acute or attenuate at apex, serrate to sinuate-margined, unlobed or occasionally with slight marginal projections, variously pubescent. Flower of medium size, 2.3–4.2 cm. long. Involucral lobes linear or sublinear. Calyx campanulate-cylindric, somewhat longer than broad, glabrous or pubescent. Mature staminal column exserted ½–⅓ its length.

Distribution: southernmost United States to Panama; West Indies (see Map 5).

Specimens examined:

UNITED STATES: TEXAS—Cameron Co.: Brownsville, *Hanson* (M), *Rose & Russell 24292* (US).

MEXICO: CHIAPAS—Escuintla, *Matuda 2153* (F, NY); Tumbala, *Nelson 3346* (NY, US). COLIMA—Manzanillo, *Ferris 6078, 6231* (US), *Palmer 963* (G, US); Paso del Rio, *Emrick 167* (F). GUERRERO—Acapulco, *MacDaniels 191* (F), *Palmer 536* (G, US);



M. arboreus var. *mexicanus*, × approx. ⅓.

Galeana, *Hinton 10897* (M, NY, US); Mina, *Hinton 9597* (A, F, M, US); San Luis, *Langlasse 924* (G, US). JALISCO—Tuxpan, *Mexia 1023* (A, F, M, NY, US). MEXICO—Temascaltepec, *Hinton 4563* (A, NY), *5254* (A, NY, US), *Hinton 6719* (A, F, NY, US). MICHOACAN—Morelia, *Arsène 2729* (A, G, M, US). MORELOS—Cuernavaca, *Pringle 9662* (G, US), *Rose, Painter & Rose 10220* (US). NAYARIT—San Blas, *Ferris 5436* (A, US), *Wright 1348* (F, M); Tepic, *Palmer 1955* (F, G, NY, US). OAXACA—Ejutla, *Conzatti 3948* (US); Jamiltepec, *Conzatti 4430* (US); Oaxaca City, *Rose & Hough 4587* (US); Oaxaca Valley, *Nelson 1223, 1256* (G, US), *Pringle 4923* (A, F, G, M, NY, US), *Smith 296* (G), *638* (M); Tuxtepec, *Nelson 348* (US); Ubero, *Williams 9189, 9219* (F). PUEBLA—Huanchinango, *Goldman 22* (G, US); Puebla, *Arsène 128, 389, 1957* (US). SAN LUIS POTOSI—Espinazo del Diablo, *Pennell 17975* (US); Rio Tampaon, *Chase 7481*

(F, G); Tamazunchale, *Edwards 482* (F, M). SINALOA—Balboa, *Ortega 5116* (US); Culiacan, *Brandegee* (G, US). TAMAULIPAS—Tampico, *Kenoyer 772* (F), *s.n.* (M). VERA CRUZ—Catemaco, *Nelson 405* (US); Coatzacoalcos, *Smith 1023, 1030* (G, US), *1030* (M); Fortuno, *Williams 8336* (F); Jalapa, *Plunkett 140* (F); Vera Cruz, *Greenman 49* (F, G, NY); without exact locality, *Orcutt 2899* (F). YUCATAN—Chichankanab, *Gaumer 1858* (F, G, M, US), *Gaumer & sons 23686* (M); Chichen Itza, *Seler 4913* (G, US), *Steere 1127, 1618, 1642* (F); Izamal, *Gaumer* (F, US), *Greenman 443* (F, G, NY); Kancabonot, *Gaumer & sons 23523* (F, G, M, US); Merida, *Schott 177* (F), *s.n.* (F, US); Progresso, *Schott 271* (F, US), *Millspaugh 1728* (F); Silam, *Gaumer* (F); Suitun, *Gaumer & sons 23361* (A, F, G, M, NY, US); exact locality unknown, *Gaumer 580* (A, F, G, M, NY, US), *Goldman 579* (US); *Millspaugh 42* (F, US), *60* (F). STATE IN DOUBT—Miramar, *Matuda 93* (US); without locality, *Berlandier 566* (US).

BRITISH HONDURAS: Corozal, *Gentle 208* (F, US), [*Lundell 4890*] (F, M).

GUATEMALA: ALTA VERA PAZ—Coban, *Tuerckheim II607* (US); Pansamala, *Tuerckheim* (F, G, US); Tactic, *Standley 90542* (M). BAJA VERA PAZ—Santa Rosa, *Standley 69853* (F), *Tuerckheim II2312* (G, US). CHIQUIMULA—Jocotan, *Steyermark 31634, 31635* (F). ESCUINTLA—El Baul, *Rojas & Tonduz 56* (US); Escuintla, *Smith 1991* (G, US), *Standley 63420, 63919* (F), *89189, 89488, 89571* (F, M); Peinha, *Pittier 1793* (US); Rio Guacalate, *Standley 58277, 60179* (F); San Jose, *Standley 64000* (F). GUATEMALA—Chilloui, *Rojos 67* (G, US); Guatemala, *Ruano 405* (US), *Tonduz 814* (US). HUEHUETENANGO—Canibal, *Shannon 307* (US). IZABAL—Quirigua, *Standley 23857* (G, NY, US). JUTIAPA—Trapiche Vargas, *Steyermark 31790* (F). PETEN—La Libertad, *Aguilar 87* (A, M). QUEZALTENANGO—Palmar, *Kellerman 5811* (US); Los Positos, *Standley 67884* (F); Volcan Santa Maria, *Steyermark 33581* (F). RETALHULEU—Ajaxa, *Standley 88240* (F, M); Las Delicias, *Standley 88014, 88119* (F, M); Nueva Linda, *Standley 66536, 66539* (F); Retalhuleu, *Standley 66702, 66719, 66775* (F), *88262* (F, M); San Felipe, *Holway 694* (US). SACATEPEQUEZ—Antigua, *Standley 60322* (F); Volcan Acatenango, *Kellerman 4806* (US); Volcan de Agua, *Standley 59465* (F). SAN MARCOS—Ocos, *Steyermark 37878* (F); Tajumulco, *Steyermark 36665* (F). SANTA ROSA—Barberena, *Standley 77752* (F, M); Cuazacapan, *Standley 78616, 78644* (F, M); La Sepultura, *Standley 79410* (F, M); Taxisco, *Standley 79019* (F, M). SUCHITEPEQUEZ—Las Animas, *Shannon 384* (US); Mazatenango, *Holway 529* (US), *Kellerman 4962* (US), *Maxon & Hay 3470* (US); Patulul, *Standley 62146* (A, F). ZACAPA—Sierra de las Minas, *Steyermark 29878* (F); Zacapa, *Deam 161* (G, NY, US), *Kellerman 9019* (F), *Standley 72026* (F), *74212* (F, M).

HONDURAS: ATLANTIDA—Tela, *Standley 55780* (F, US). COMAYAGUA—Siguatepeque, *Yuncker, Dawson & Youse 5680* (F, G, M). YORO—Pijol, *C. & W. von Hagen 1104* (F, NY). WITHOUT EXACT LOCALITY—La Lima, *Johansen 29* (F).

SALVADOR: AHUACHAPAN—Ahuachapan, *Standley 19718a, 19855* (G, NY, US); without exact locality, *Padilla 193* (US), *197* (A, M, US). LA UNION—La Union, *Standley 20809* (G, US). SONSONATE—Armenia, *Standley 23520* (G, US); Finca Chilata, *Standley 19339* (G, NY, US); Izalco, *Standley 21837* (G, NY, US); Sonsonate, *Standley 22300* (G, NY, US).

NICARAGUA: MASAYA—Masaya, *Baker 163* (G, M, NY), *618* (US). DEPT. IN DOUBT—Braggman's Bluff, *Englesing 75, 94* (F); without exact locality, *Wright* (G, M, US).

COSTA RICA: CARTAGO—Carpintera Mt., *Stork 333* (US); Cartago, *Cooper 5719* (F, US); San Rafael, *Pittier 9030* (US). GUANACASTE—Cruz de Guanacaste, *Pittier 2770* (US); Hacienda Santa Maria, *Dodge & Thomas 6324* (M); Los Conventillos, *Tonduz 2884* (US); Nicoya, *Cooper 10367* (US), *Tonduz 13485* (G, M). PUNTARENAS—Santo Domingo del Golfo Dulce, *Tonduz 6982* (US). SAN JOSE—Guadaloupe, *Greenman 5433* (M); La Verbena, *Standley 32230* (US), *Tonduz 8946* (US); San Jose, *Tonduz 1092* (US). PROVINCE IN DOUBT: Ochonogo, *Pittier 59* (US).

PANAMA: CHIRIQUÍ—Bajo Mona, *Woodson & Schery 531* (M); Boquete, *Pittier 2925, 3138* (US); Pena Blanca, *Woodson & Schery 302* (M); Quebrada Velo, *Woodson & Schery 276* (M); New Switzerland, *Allen 1364* (F, G, M, NY); Peninsula de Burica, *Woodson & Schery 932* (M). COCLÉ—El Valle, *Allen 91* (A, G, M), *1176* (F, M) *P. & G. White 70* (G, M). DARIEN—Tucuti, *M. E. & R. A. Terry 1386* (M). PANAMÁ—Taboga Island, *Standley 27924* (US). VERAGUAS—Sona, *Allen 1045* (F, G, M).

WEST INDIES: BAHAMAS—Watlings Island, *Britton & Millspaugh 6145* (US). CUBA—Havana, *Britton & Wilson 4535* (F); Oriente, *Ekman 2976* (F); Pinar del Rio, *Palmer & Riley 597* (US), *van Hermann 253* (F, NY), *Wilson & Leon 11297* (US); Sierra de Omafe, *Leon 4745* (NY). JAMAICA—Blue Mountain Peak, *Hitchcock* (M); Cinchona, *Harris & Lawrence C15297* (US), *Marble 193* (NY), *Rehder* (A); Diabolo Mt., *Maxon & Killip 398* (US); Gordon Town, *Hart 571* (US); John Crow Mts., *Britton 3995* (NY); Latimer River, *Nichols 63* (NY, US); Lucea, *Britton 2917* (NY); Mandeville, *Britton 999* (NY); *Brown 78* (NY); Negril, *Britton & Hollick 2093* (NY); Port Antonio, *Hitchcock* (F, M), *Millspaugh 931* (F, NY), *Wight 22* (F, NY); Rio Grande, *Millspaugh 1920* (F); Walderston, *Harris 12863* (F, G, M, NY, US); Wavels Rock, *Fawcett 8022* (NY); without exact locality, *Alexander* (M). TRINIDAD—Queen's Royal College grounds, *Broadway 7690* (F, M); St. Ann's, *Broadway 7324* (NY).

COLOMBIA: ANTIOQUIA—San Geronimo, *Tomas 622* (US). ATLANTICO—Barranquilla, *Elias 655* (US). BOYACA—Uvita, *Cuatrecasas 1850* (US). CUNDINAMARCA—San Javier, *Aristé-Joseph* (US); Tabio, *Antonio 16E* (US). MAGDALENA—Aracataca, *Dugand & Barriga 2476* (US). SANTANDER—Badillo, *Pennell 3910* (NY, US).

The only character which separates this variety from varieties *penduliflorus* and *cubensis* is the flower size. Admittedly arbitrary limits are given for flower size, but this is necessary in view of the fact that complete intergradation occurs between these varieties. Here the flower is smaller and less robust than in var. *penduliflorus*, with the mature staminal column, as a rule, more exserted. On the other hand, the flowers are not as dwarfed as in var. *cubensis* and the staminal column is usually less exserted.

3g. Malvaviscus arboreus var. **palmanus** (Pittier & D. Smith) Schery, n. comb.

Malvaviscus palmanus Pittier & D. Smith in Bot. Gaz. **23**: 238. 1897.

Shrub or vine-like plants with upper branches, pedicels, and petioles generally thickly pubescent with short stellate hairs, sometimes also with longer straight hairs, or almost glabrous. Leaves entire, almost symmetrically elliptic, broadest at the middle, usually large when mature (as long as 20 cm. in extreme cases), 2 to 4 times as long as broad, with 3 prominent palmate veins from which smaller reticulate veins emerge almost at right-angles, stellate-pubescent on both surfaces; margins shallowly dentate or sinuate. Flowers large, usually 4–5 cm. long. Involucral lobes essentially linear. Mature staminal column exserted ⅓–⅕ its length.

Distribution: Costa Rica (see Map 2).

Specimens examined:

COSTA RICA: ALAJUELA—La Ventolera, *Standley 34685* (US); San Carlos, *Smith H1670* (F, M); San Ramon, *Brenes 5954, 13418, 21969, 21982, 22623* (F); Viento Fresco, *Standley & Torres 47926* (US); CARTAGO: Orosi, *Standley 39640, 39837* (US). GUANACASTE—El Silencio, *Valerio 66* (US); Tilaran, *Brenes 15630* (F), *Standley & Valerio 44605, 46238* (US). HEREDIA—San Frideo, *Pittier 14015* (US); Vara Blanca de Sarapiqui, *Skutch 3266* (A, M). SAN JOSE—La Hondura, *Standley 36585* (US); La Palma, *Maxon & Harvey 8004* (US), *Standley 33209* (US), *Stevens 301* (US), *Tonduz 7393* (F, G, M, US), *8089, 12465* (NY, US); PROVINCE IN DOUBT: Zarcero, *Smith H20* (F, M), *A316* (F); without exact locality, *Smith? 7393* (M).

M. arboreus var. *palmanus*, × approx. ⅓.

This variety approaches vars. *penduliflorus* and *mexicanus* but can be distinguished by its almost perfectly elliptic leaves.

3h. Malvaviscus arboreus var. **penduliflorus** (DC.) Schery, n. comb.

Malvaviscus penduliflorus Moc. & Sessé ex DC. Prodr. **1**: 445. 1824; ex A. DC. Calq. des Dess. *pl. 90.* 1874; Standl. in Contr. U. S. Nat. Herb. **23**: 774. 1923.

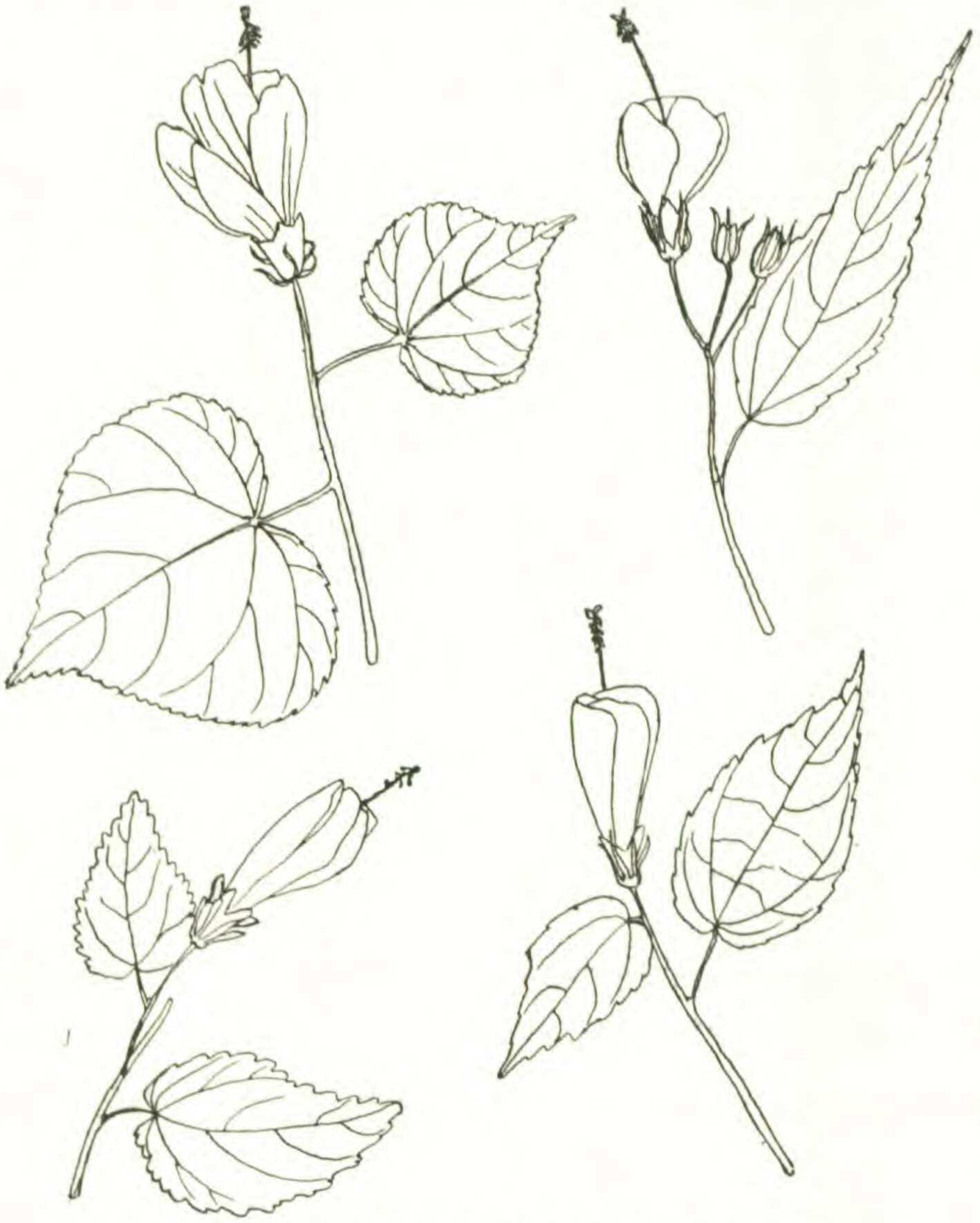
Malvaviscus oligotrichus Turcz. in Bull. Soc. Nat. Mosc. **31**: 190. 1858.

Malvaviscus glabrescens Planch. & Lind. ex Triana & Planch. in Ann. Sci. Nat. Bot. IV, **17**: 168. 1862, nomen nudum in synon. (= *M. oligotrichus* fide Triana & Planch.).

Malvaviscus lanceolata Rose in Contr. U. S. Nat. Herb. **5**: 175. 1899.

Malvaviscus Conzattii Greenm. in Field Col. Mus. Bot. **2**: 333. 1912; Standl. in Contr. U. S. Nat. Herb. **23**: 774. 1923.

Bushy or vine-like shrubs; upper branches, pedicels, and petioles with long (1.0–1.5 mm.) hairs, or glabrous. Leaves lanceolate or ovate-lanceolate, rounded or cordate at base, acute or attenuate at apex, serrate to sinuate-margined, variously pubescent. Flower robust, longer than 4.2 cm., often appearing abruptly truncate at



M. arboreus var. *penduliformis*, × approx. ⅓.

the tip in herbarium specimens. Involucral lobes essentially linear in southern part of plant range, often broader and more or less spatulate in northern part. Calyx more or less cylindric, somewhat longer than broad, glabrous or lightly haired. Mature staminal column exserted ⅓–¼ its length.

Distribution: widespread, from central Mexico to Colombia (see Map 4).

Specimens examined:

MEXICO: CHIAPAS—Chicharras, *Nelson 3807* (G, US); La Illusion, *Mell 2019* (US); San Cristobal, *Nelson 3170* (US). GUERRERO—Chilacayote, *Hinton 14181* (G); Petlacala,

Mexia 9094 (G, M, NY); Pilas Pasion Filo Mayor, *Hinton 10753* (F, M, US); Plan de Carrizo, *Hinton 11030* (G); San Marcos, *Nelson 2264* (US); Sierra Madre, *Langlasse 793* (G, US). JALISCO—Puerto Vallarta, *Mexia 1135* (A, F, M, NY, US); Santa Cruz de Vallarta, *Mexia 1267* (US); San Sebastian, *Mexia 1442* (A, F, G, M, NY, US). MEXICO—Temascaltepec, *Hinton 4014* (A, NY, US). MICHOACAN—Zitacuaro, *Hinton 13529* (G). MORELOS—Cuernavaca, *MacDaniels 305* (F), *Rose & Hough 4351* (US). OAXACA—Cafetal Concordia, *Morton & Makrinius 2391* (F, US), *Reko 3348* (US); Comaltepec, *Nelson 926* (US); Plunia, *Nelson 2500* (NY, US); San Pablo Huitzo, *Conzatti 1981* (F); Santo Domingo, *Conzatti 1683* (F, US); Yaveo, *Mexia 9204* (G, M, NY). PUEBLA—Piaxtla, *Nelson 2016* (US). QUERETARO—Cerro de las Campañas, *Arsène 10058* (F, M, US); without exact locality, *Agniel 10525* (A, F, G, M, US). SINALOA—without further locality, *Ortega 7327* (F). VERA CRUZ—Cordoba, *Schery 188* (M); Tampico, *Palmer 391* (M, NY, US). STATE IN DOUBT—from Mexican seed, *Rose 4027* (US).

GUATEMALA: ALTA VERA PAZ—Panzos, *Maxon & Hay 3080* (US); Saxoc, *Tuerckheim 8185* (US). BAJA VERA PAZ—Paujal, *Tuerckheim II1721* (US). CHIMALTENANGO—Quisache, *Standley 62039* (A, F), *62048* (F). IZABAL—Boca del Polochic, *Smith 1658a* (US); Quirigua, *Standley 24587* (G, NY, US), *72311* (F). QUEZALTENANGO—Aguas Amargas, *Standley 65416* (F); Chiquihuite, *Standley 68102, 68112* (F); Santa Maria de Jesus, *Standley 68236* (F, NY), *Steyermark 33386* (F); Volcan Zunil, *Skutch 878* (A, F). RETALHULEU—San Felipe, *Steyermark 34516* (F). SOLOLA—Volcan Atitlan, *Hatch & Wilson 360* (F).

HONDURAS: ATLANTIDA—La Ceiba, *Yuncker, Koepper & Wagner 8523* (F, M, NY); Tela, *Mitchell 131* (F, G), *Standley 53743* (A, F, US), *54021* (F), *54786* (A, F, US). SANTA BARBARA—San Pedro Sula, *Bangham 341* (A), *Thieme 5153* (G, NY, US). YORO—Guaymas district, *Standley 55493* (A, F, US); Quebrada Seca, *Standley 53926* (A, F, US); Progresso, *Standley 54987* (A, F, US). DEPT. IN DOUBT—Puerto Sierra, *Wilson 42* (NY, US).

NICARAGUA: ATAGALPA—Jinotega, *Grant 7298* (A).

COSTA RICA: ALAJUELA—Capulin, *Standley 40163* (US); Naranjo, *Stork 1828* (F); Palmira, *Smith 4215* (F); San Pedro, *Brenes 16998* (F). CARTAGO—Cartago, *Holway 276* (US), *Standley & Valerio 49600* (US), *Stork 2834* (F); Cerro Carpintera, *Dodge & Thomas 4784* (M), *Standley 35756* (US); Irazu Volcano?, *Pittier 13063* (US). GUANACASTE—Culebra Bay, *Pittier 12020* (US). HEREDIA—Puerto Viejo & Sarapiqui River, *Biolley 7403* (US); Santo Domingo del Roble, *Dodge & Goerger 9582* (F, M). LIMON—La Colombiana farm of United Fruit Co., *Standley 36978* (US). SAN JOSE—El General, *Skutch 2368* (A, G, M, NY, US); San Francisco de Guadalupe, *Pittier 13031* (US), *Tonduz 6973* (G, US); San Jose, *Biolley 43* (F), *Holway 402* (US), *Tonduz 7260* (US); Santa Maria de Dota, *Standley 41845* (F, US), *Standley & Valerio 43278* (F, US), *Stork 2975* (F); Tucurrique on Las Vueltas River, *Tonduz 13149* (US); Ciruelas River, *Tonduz 2218* (US); San Isidro Coronado, *Alfaro 32378* (F, US); Llanuras de Santa Clara, *Smith 6450* (US).

PANAMA: BOCAS DEL TORO—Almirante, *Cooper & Slater 26* (US), *Cooper 103* (F, NY); Bocas del Toro?, *Carleton 81* (NY, US); Changuinola River, *Dunlap 101* (F), *349* (F, G, US), *440* (F). CHIRIQUÍ—Bajo Chorro, *Davidson 68* (A, F, M); Bajo Mona, *Woodson & Schery 550* (M); Boquete, *Maxon 5000* (US); Cerro Punta, *Seibert 263* (A, M, NY); San Felix, *Pittier 5210* (NY, US). COCLÉ—El Valle, *Allen 1906* (M), *Woodson & Schery 188* (M). PANAMÁ—Rio la Maestra, *Allen 52* (A, G). PROVINCE IN DOUBT—western Panama, *Stork 101* (US).

COLOMBIA: BOLIVAR—Cartagena, *Killip & Smith 14052* (A, G, NY, US); Turbaco, *Killip & Smith 14187* (G, US). CAQUETA—Cordillera Oriental, *Cuatrecasas 9153* (US). MAGDALENA—Santa Marta, *Smith 492* (NY), *734* (A, F, G, M, NY, US), *735* (F, G, M, NY, US), *2727* (G, NY), *2816* (NY). SANTANDER—Barranca Bermeja, *Haught*

1532 (F, US); California, *Killip & Smith 16890* (G, US). DEPT. IN DOUBT—Fouinne?, *Arbelaez 2456* (US).

VENEZUELA: DISTRITO FEDERAL—Cerros del Avila, *Pittier 49* (NY, US); Galipan, *Pittier 83* (NY, US).

ECUADOR: PROVINCE IN DOUBT—La Chonta, *Rose, Pachano & Rose 23478* (NY, US).

This variety shows complete intergradation with var. *mexicanus* from which it must be separated rather arbitrarily. The difference between these varieties is in the flower, var. *penduliflorus* having a more robust flower, almost always greater in length than the arbitrary limit of 4.2 cm.

3i. Malvaviscus arboreus var. **sepium** (Schlecht.) Schery, n. comb.

Malvaviscus sepium Schlecht. in Linnaea **11**: 361. 1837; Standl. in Contr. U. S. Nat. Herb. **23**: 775. 1923, as syn.

M. arboreus var. *sepium*
× approx. ⅓.

M. arboreus var. *Williamsii*
× approx. ⅓.

Shrub with upper branches, pedicels, and petioles lightly or thickly pubescent with long (1.0–1.5 mm.) hairs, pubescence usually decurrent in ridges on petiole and stem. Leaves small (less than 10 cm. long, usually about 6 cm.), 1.5–3.5 times as long as broad, lanceolate to ovate-lanceolate, bluntly dentate, unlobed, upper leaf-surface predominantly straight-haired, lower surface with few to many straight hairs interspersed among stellate hairs. Flower small, 2.0–3.2 cm. long. Involucral lobes spatulate. Mature staminal column exserted ½–⅓ its length.

Distribution: Vera Cruz and occasional elsewhere in northeastern Mexico (see Map 2).

Specimens examined:

MEXICO: NUEVO LEON—Monterrey, *collectors unkonwn* (F, US). VERA CRUZ—Cordoba, *Bourgeau 1512, 1669* (G, US), *Greenman 191* (F, G); Coscomatepec, *Matuda 1310*

(F); Fortin, *Fisher 35506* (F); Jalapa, *Barnes, Chamberlain & Land 34* (F), *MacDaniels 944* (F), *Orcutt 2811* (F, M), *Plunkett 45* (F), *Pringle 7833* (G, US), *8202* (A, F, G, M, NY, US), *Rose & Hay 6184* (NY, US), *Rose & Hough 4245* (US); Mirador, *Mohr* (US); Nogales, *Seaton 300* (F, G, US); Orizaba, *Fisher 152* (US, F, M), *Mohr* (US), *Pringle 5914* (US); Azcuapan, *Purpus 7430* (G, M, US), *10729* (US).

This variety is close to var. *mexicanus* and is best distinguished by the spatulate involucral lobes, the small flowers and leaves, and the predominantly straight-haired pubescence of the upper leaf surface.

3j. Malvaviscus arboreus var. **Williamsii** (Ulbrich) Schery, n. comb.

Malvaviscus Williamsii Ulbrich in Notizblatt **11**: 545. 1932.

Shrub-like plant with upper branches, pedicels and petioles stellate-pubescent, often densely so. Leaves broadly lanceolate to triangular, cordate at base, unlobed or occasionally with small marginal projections, shallowly or deeply dentate, usually predominantly stellate-pubescent on both surfaces. Flowers large, 4–6 cm. long. Involucral lobes large, more or less foliaceous, lanceolate or ovate-lanceolate, 4–8 mm. broad near the base, more or less covering and concealing the long-cylindric, yellow-setose calyx. Mature staminal column exserted ⅓–⅙ its length.

Distribution: Peru and Colombia (see Map 3).

Specimens examined:

COLOMBIA: PUTUMAYO—Umbria, *Klug 1712* (F). DEPT. IN DOUBT—Tocamet, *Schott 3* (F).

PERU: LORETO—Florida, *Klug 2077* (A, F, G, M, NY, US); Gamitanacocha, *Schunke 293* (A, F, NY, US).

This variety is close to var. *longifolius* which it resembles especially in calyx and leaf characters. However, it is the only variety with large, broad involucral lobes.

PAVONIA Cav.

4. Pavonia firmiflora Schery, n. sp.

Frutex undique stellato-pubescens; foliis maturis subrotundis, magnis, ca. 14 cm. longis, 12 cm. latis, aliquid 3–5-lobatis lobis mediis prominentibus, profunde cordatis, subtus pallidioribus et pubescentioribus, 7–9 venis prominentibus palmatis; petiolis folia aequantibus vel longioribus; floribus terminalibus brevi-racemiformibus; pedicellis 0.5–6.0 cm. longis; involucris subpatelliformibus ca. 8–9-lobatis, stellato-pubescentissimis, lobis linearibus, acutis; calycibus 1.0–1.5 cm. diametro, extus stellato-pubescentibus,

intus brevi-mollissimis, 5-lobatis, lobis lanceolatis; petalis obovatis, inaequilateralibus, retusis, non-auriculatis, 3.5–4.0 cm. longis; tubis staminalibus non exsertis, columniformibus, supra medium in filamenta congesta monanthera divisis, apice nudis, dentatis; ovariis subglobosis, rigide pubescentissimis, 5-carpellatis, carpellis uniovulatis et monoseminatis; stylis 10; fructibus juventate rigide pubescentissimis; seminibus subreniformibus, glabris.

Distribution: Jalisco, Mexico (see Map 6).

Specimens examined:

MEXICO: JALISCO—Tequila, *Pringle 5447* (F, G, M TYPE, NY, US).

Pavonia firmiflora, × approx. 1/5.

The Pringle specimens have for almost 50 years been labeled in herbaria as "*Malvaviscus acerifolius* Presl. (ex. char.)." Only this collection *(Pringle 5447)* has ever been made of specimens referable to the new species, *P. firmiflora*. The specimens differ from those of the original description of *Malvaviscus acerifolius* especially in having stiffly pubescent fruit and a shortened staminal column. A comparison of *Pavonia firmiflora* with a photograph of the *M. acerifolius* type specimen shows *P. firmiflora* to have a coarser, stouter appearance and different leaf texture.

Pavonia firmiflora is close to *Pavonia Palmeri* (Baker) Schery (formerly *Malvaviscus Palmeri)*, but has much larger flowers, a condensed inflorescence, and only slightly lobed leaves. It is possible that *P. firmiflora* is a hybrid between *Pavonia Palmeri* and

perhaps *Malvaviscus candidus.* The fact that only one collection has ever been made would tend to support this view.

The border-line between *Pavonia* and *Malvaviscus* is vague. It is difficult to tell where a fleshy fruit stops and a dry fruit begins, to use this classical character of demarcation between *Malvaviscus* and *Pavonia.* This is true of *Pavonia firmiflora;* yet *P. firmiflora* is so similar to *P. Palmeri* that inclusion in the genus *Pavonia* seems entirely warranted, especially since *P. firmiflora* does not have auriculate petals, an additional definite character of *Pavonia,* sug-

Pavonia Palmeri, × approx. ⅕.

gested in the introduction to this monograph for use in distinguishing between *Malvaviscus* and *Pavonia.*

The whole *P. firmiflora* plant has a coarse, dense, stellate pubescence. The cordate leaves are slightly lobate, a lighter gray color and more densely pubescent on the under side than above. The inflorescence is almost a condensed raceme, although occasional flowers are axillary in the upper leaves. The involucre is broad, with narrow linear-lanceolate lobes, shorter than the robust calyx. The calyx is minutely pannose within, with a circular bare area at the base surrounding the 5-carpellate densely haired ovary. There is one subreniform seed almost completely filling each carpel.

5. Pavonia Palmeri (Baker) Schery, n. comb.

Malvaviscus Palmeri Baker f. ex Rose in Contr. U. S. Nat. Herb. **3**: 313. 1895.

Malvaviscus cinereus Baker f. ex Robins. & Greenm. in Am. Jour. Sci. III, **50**: 176. 1895, nomen; E. G. Baker in Jour. Bot. **37**: 347. 1899.

Pavonia amplifolia Standl. in Pub. Field Mus. Bot. **4**: 230. 1929.

Distribution: western Mexico (see Map 6).

Specimens examined:

MEXICO: JALISCO—San Sebastian, *Mexia 1480* (F, G, M), *Nelson 4061* (G, US). NAYARIT—Tepic, *Palmer 1835*, in part (F, G), *1990* (F, G, NY, US).

The transfer of this species from *Malvaviscus* to *Pavonia* is made on the basis of the general structure of flower and fruit. The petals are not auriculate and the fruit can scarcely be termed "fleshy."

EXCLUDED SPECIES

Malvaviscus cinereus Baker f. ex Rob. & Greenm. in Am. Jour. Sci. III, **50**: 176. 1895, nomen subnudum; E. G. Baker in Jour. Bot. **37**: 347. 1899 = **Pavonia Palmeri** (Baker) Schery.

Malvaviscus coccineus Medic. Malv. 49. 1787 = **Hibiscus coccineus** Walt., fide Ind. Kew., probably **Pavonia** sp.

Malvaviscus floridanus Nutt. in Jour. Acad. Phila. **7**: 89. 1834 = **Hibiscus Bancroftianus** Macfad., fide Ind. Kew.

Malvaviscus fragilis Bory ex DC. Prodr. **1**: 446. 1824, as syn. = **Hibiscus liliiflorus** Cav., fide Ind. Kew. *(H. fragilis* DC. loc. cit).

Malvaviscus longifolius Spach, Hist. Veg. Phan. **3**: 370. 1834 = **Pavonia longifolia** A. St. Hil., fide Ind. Kew.

Malvaviscus montanus Mart. ex Garcke, Jahrb. Bot. Gart. Berlin **1**: 222. 1881 = **Pavonia montana** Garcke, fide Ind. Kew.

Malvaviscus multiflorus Spach, loc. cit. 1834 = **Pavonia multiflora** A. St. Hil., fide Ind. Kew.

Malvaviscus Palmeri Baker f. ex Rose in Contr. U. S. Nat. Herb. **3**: 313. 1895 = **Pavonia Palmeri** (Baker) Schery (see above).

Malvaviscus populifolius Presl, Reliq. Haenk. **2**: 135. 1853 = **Hibiscus** sp., as judged from the description.

Malvaviscus populneus Gaertn. Fruct. **2**: 253, *pl. 135, fig. 3.* 1791 = **Thespesia populnea** Soland., fide Ind. Kew.

Malvaviscus puniceus Bory ex DC. loc. cit. 446. 1824, as syn. = **Hibiscus liliiflorus** Cav., fide Ind. Kew.

Malvaviscus rosa-sinensis Moench ex Steud. Nom. Bot. ed. 2. **1**: 760. 1841 = **Hibiscus rosa-sinensis** L., fide Steud.

SPECIES OF DOUBTFUL STATUS

Achania cordata Nees & Mart. in Nov. Act. Nat. Cur. **11**: 99. 1823, not *Malvaviscus,* probably *Pavonia.* Same as *Pavonia coccinea* Willd., fide Nees & Mart.

Achania floridana Raf. New Fl. N. Am. 1: 4. 1836? = **Hibiscus Bancroftianus** Macfad. *(H. floridanus* Shuttlew.), fide Ind. Kew.

Achania Poeppigii Spreng. Syst. **3**: 100. 1826 = **Hibiscus Poeppigii** Garcke, fide Ind. Kew. (see *Malvaviscus Poeppigii).*

Achania stylosa Schrank in Flora **2**: 449. 1819, nomen dubium.

Achania tomentosa Sterler ex Steud. Nom. Bot. ed. 2, **1**: 12. 1841, nomen nudum.

Anotea chlorantha (Malvaviscus chloranthus) Kth. ex Ulbrich in Fedde's Rep. Spec. Nov. **14**: 108. 1915, probably **Pavonia** sp. as judged from photograph of type and from the description.

Anotea flavida (DC.) Ulbrich, loc. cit. 109. 1915, genus and species doubtful, probably **Pavonia** sp.

Malvaviscus flavidus Moc. & Sessé ex DC. Prodr. **1**: 446. 1824, genus and species doubtful, probably **Pavonia** sp.

Malvaviscus pleurantherus Moc. & Sessé ex DC. loc. cit. 1824, genus and species doubtful.

Malvaviscus pleurogonus Moc. & Sessé ex DC. loc. cit. 1824, genus and species doubtful.

Malvaviscus Poeppigii (Spreng.) G. Don, Gen. Syst. Dichl. Pl. **1**: 475. 1831, nomen dubium = **Hibiscus Poeppigii** Garcke, fide Ind. Kew. Perhaps, were the description more complete and definitive, this name should be included as a synonym of **Malvaviscus arboreus** var. **mexicanus.**

Index to Specimens Cited

The number in italics refers to the collection number, the number in parentheses to the species or variety under which the specimen is cited: (1)—*M. candidus;* (3)—*M. arboreus;* (3a)—var. *brihondus;* (3b)—var. *cubensis;* (3c)—var. *Drummondii;* (3d)—var. *Hintoni;* (3e)—var. *longifolius;* (3f)—var. *mexicanus;* (3g)—var. *palmanus;* (3h)—var. *penduliflorus;* (3i)—var. *sepium;* (3j)—var. *Williamsii;* (4)—*P. firmiflora;* (5)—*P. Palmeri.*

Agniel, Bro. *10525* (3h); *10621* (1).
Aguilar, M. *87* (3f).
Alexander, R. C. — (3f).
Alfaro, A. *32378* (3h).
Allart, A. *76* (3c).
Allen, P. H. *52* (3c); *91, 1045, 1176, 1364* (3f); *1906* (3h).
André, E. K. *K862* (3e).
Antonio, Bro. *16E* (3f).
Arbelaez, E. P. & J. Cuatrecasas. *2456* (3h); *6565* (3).
Aristé-Joseph, Bro. *A975, 1060* (3); — (3f).
Arsène, Bro. G. *34* (3); *128, 389, 1957* (3f); *2729* (3, 3f); *5494* (3); *10058* (3h).

Artemio, Bro. *72* (3).

Baker, C. F. *7* (3); *163, 618* (3f); *824* (3).
—— & H. A. Van Hermann. *4253* (3b).
Bangham, C. M. *341* (3h).
Barber, H. S. *23* (3c).
Barnes, C. R., C. J. Chamberlain & W. J. G. Land. *34* (3i).
—— & W. J. G. Land. *203* (3).
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Berlandier, J. L. *566* (3f).
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Britton, N. L. *999, 2917, 3995* (3f).
—— & J. F. Cowell. *9902* (3b).
—— & A. Hollick. *2093* (3f).
—— & C. F. Millspaugh. *2442* (3b); *6145* (3f).
—— & P. Wilson. *511* (3); *4535* (3f); *14032* (3b).
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—— & V. Gonzalez. *27* (3).
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—— & G. M. Slater. *26* (3h).
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—— & W. S. Thomas. *4784* (3h); *6324* (3f).
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Dugand, A. *887* (3e).
—— & Barriga. *2476* (3f).
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—— & C. D. Duncan. *3150* (3c).
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Marble. *193* (3f).
Matuda, E. *83* (3f); *95* (3); *1310* (3i); *2153* (3f).
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—— & A. D. Harvey. *8004* (3g).
——, —— & A. T. Valentine. *7275, 7353, 7450* (3).
—— & R. Hay. *3080* (3h); *3470* (3f).
—— & E. P. Killip. *398* (3f).
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Index to Specific and Varietal Names

New names, varieties and combinations are printed in **bold-face** type, synonyms in *italics*, and valid names in Roman type.

EXPLANATION OF PLATE

PLATE 14

Cutting from a plant of *Malvaviscus arboreus* var. *penduliflorus*, showing unusual morphology in the first formed leaves.

SCHERY—MONOGRAPH OF MALVAVISCUS

EXPLANATION OF PLATE

PLATE 15

Figs. 1–6. Six different specimens of *M. arboreus* vars. *mexicanus* and *penduliflorus* collected in the same locality in Chiriquí, Panama. Note the variation in leaf and petal shape, number and form of calyx and involucral lobes, differences in leaf margin, etc. The specimen of fig. 3 would be classified as var. *penduliflorus* on the basis of flower size, while the other specimens would fall into the var. *mexicanus* group. The specimens of figs. 1 and 2 would be almost on the border-line between these two varieties. × ½.

SCHERY—MONOGRAPH OF MALVAVISCUS

EXPLANATION OF PLATE

PLATE 16

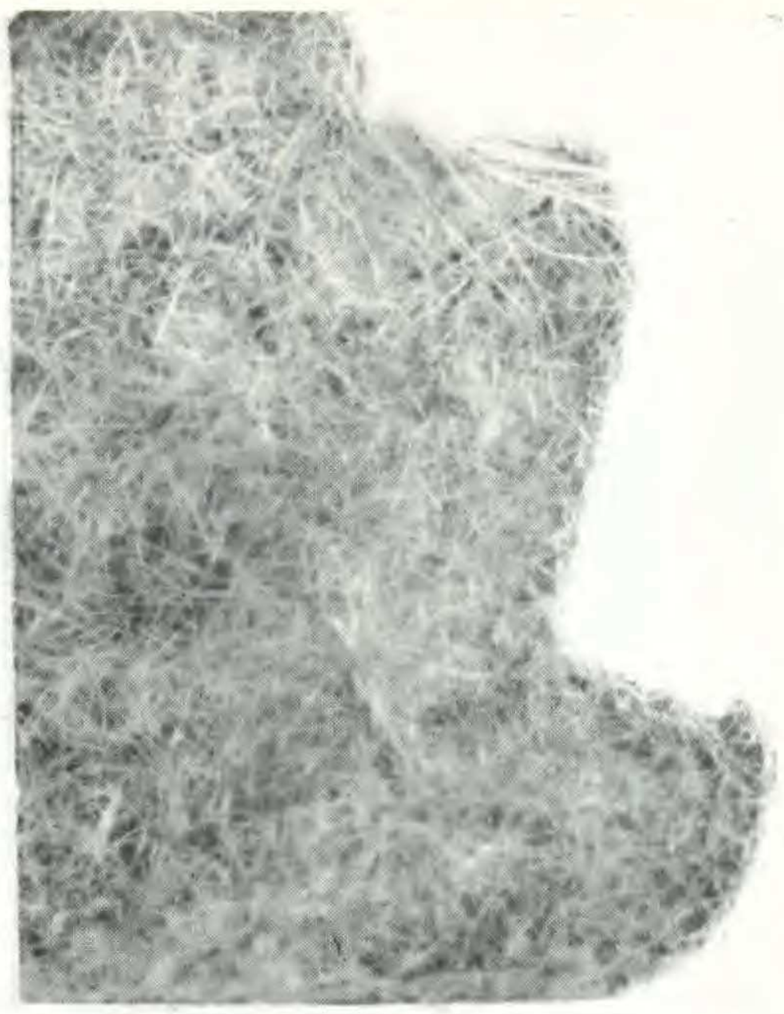
Fig. 1. Two leaves from the same plant of *M. arboreus* var. *penduliflorus* growing in the Missouri Botanical Garden greenhouse. × ⅔.

Fig. 2. Dense velvety pubescence of lower surface of a leaf of *M. arboreus*. × 10.

Fig. 3. Stellate pubescence on upper surface of a leaf of *M. arboreus* var. *brihondus*. Note occasional larger hairs. × 10.

Fig. 4. Glabrous upper surface of a leaf of *M. arboreus* var. *mexicanus*. Note the longitudinal ridge of hairs on the upper side of the petiole in this specimen. × 10.

1



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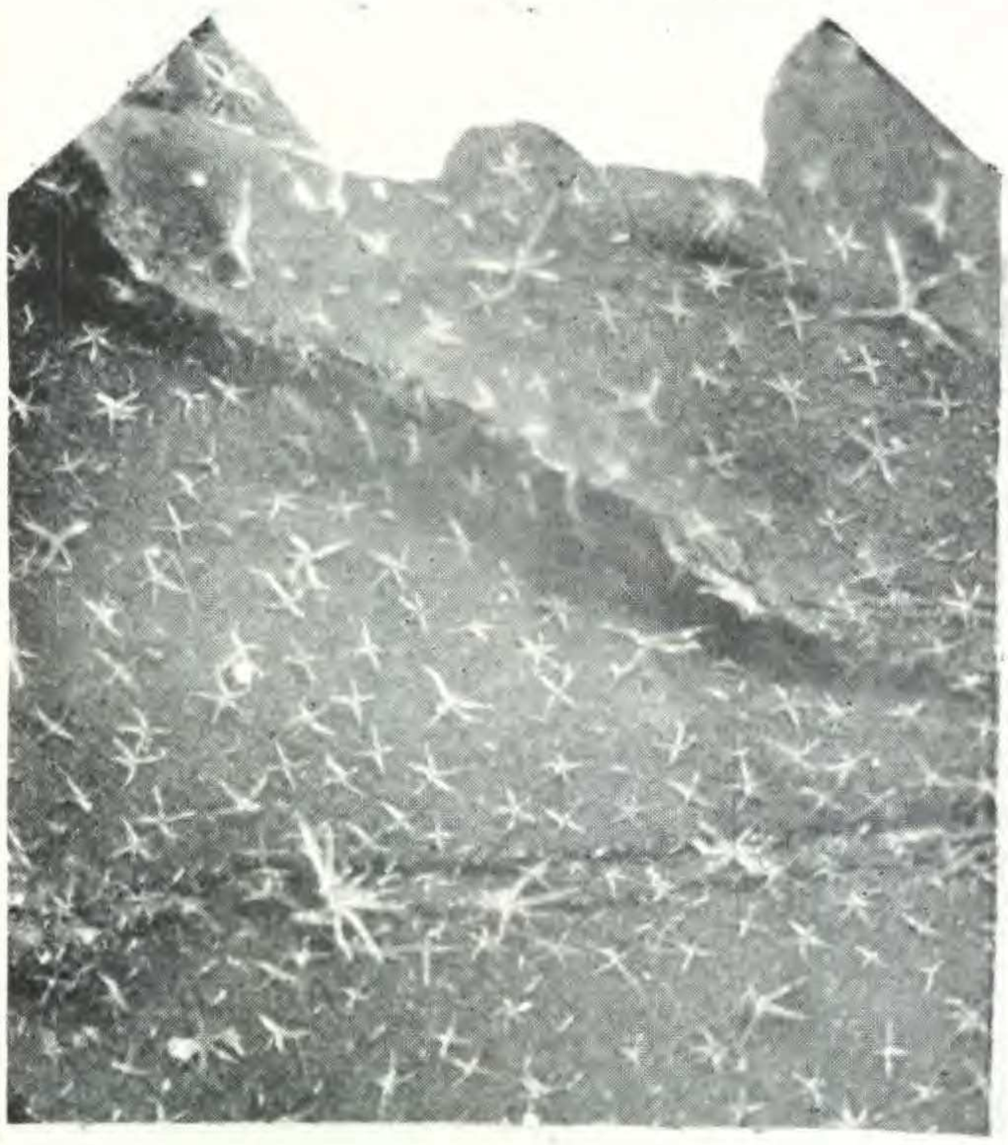

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EXPLANATION OF PLATE

PLATE 17

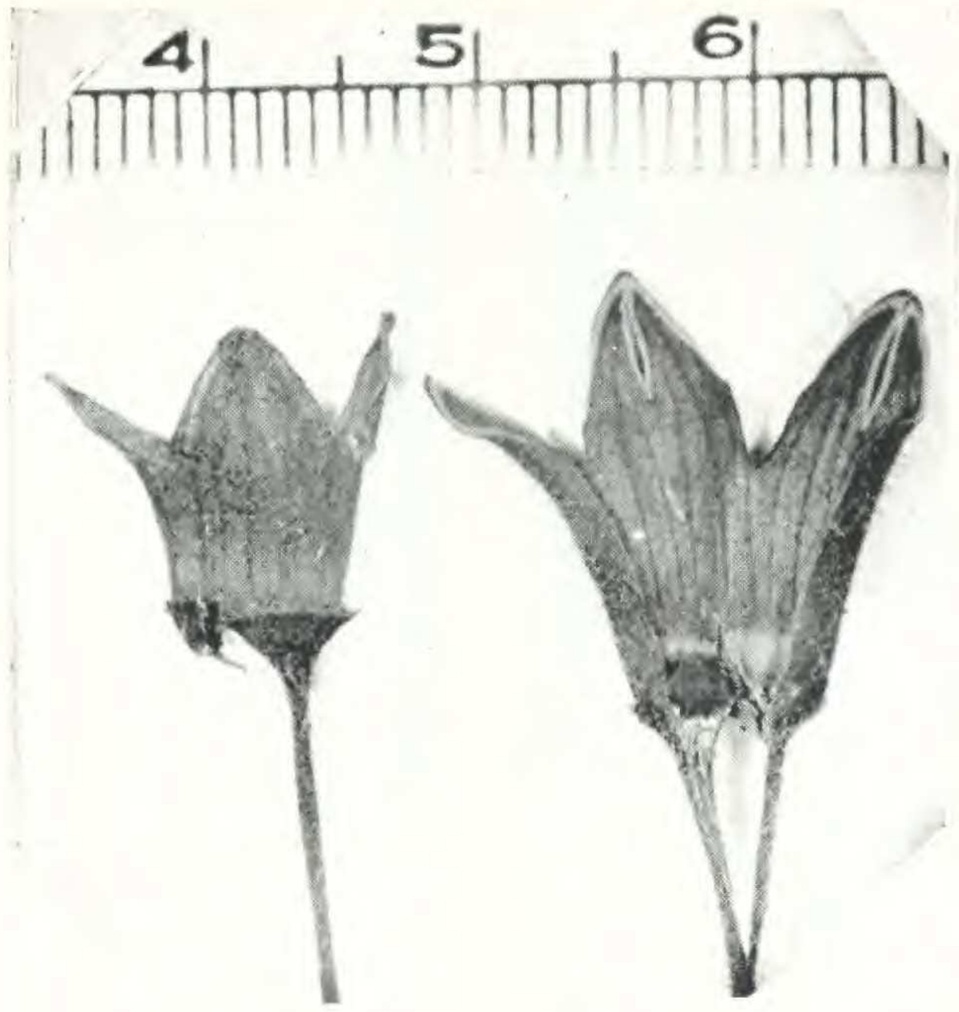
Fig. 1. Calyx of *M. arboreus* var. *mexicanus* with other floral organs removed: left—external view; right—calyx split open to show inner surfaces. × 4.

Fig. 2. Single petal of *M. arboreus* var. *mexicanus*. × 2.5.

Fig. 3. Upper portion of staminal column in three specimens of *M. arboreus* var. *mexicanus*. Note the erect position of the style branches and the five-toothed tip of the staminal column in the younger (upper) specimen. × 4.

Fig. 4. Involucre of *M. arboreus* var. *mexicanus* with all other floral organs removed: upper—involucre split open with inner surfaces exposed; lower—external view. × 4.

Fig. 5. Upper row, from left to right: empty opened carpel, seed, seed in position in opened carpel, single unopened carpel, and mature fruit of *M. arboreus* var. *mexicanus*. Lower row: same for *M. candidus* except mature fruit is omitted. × 2.



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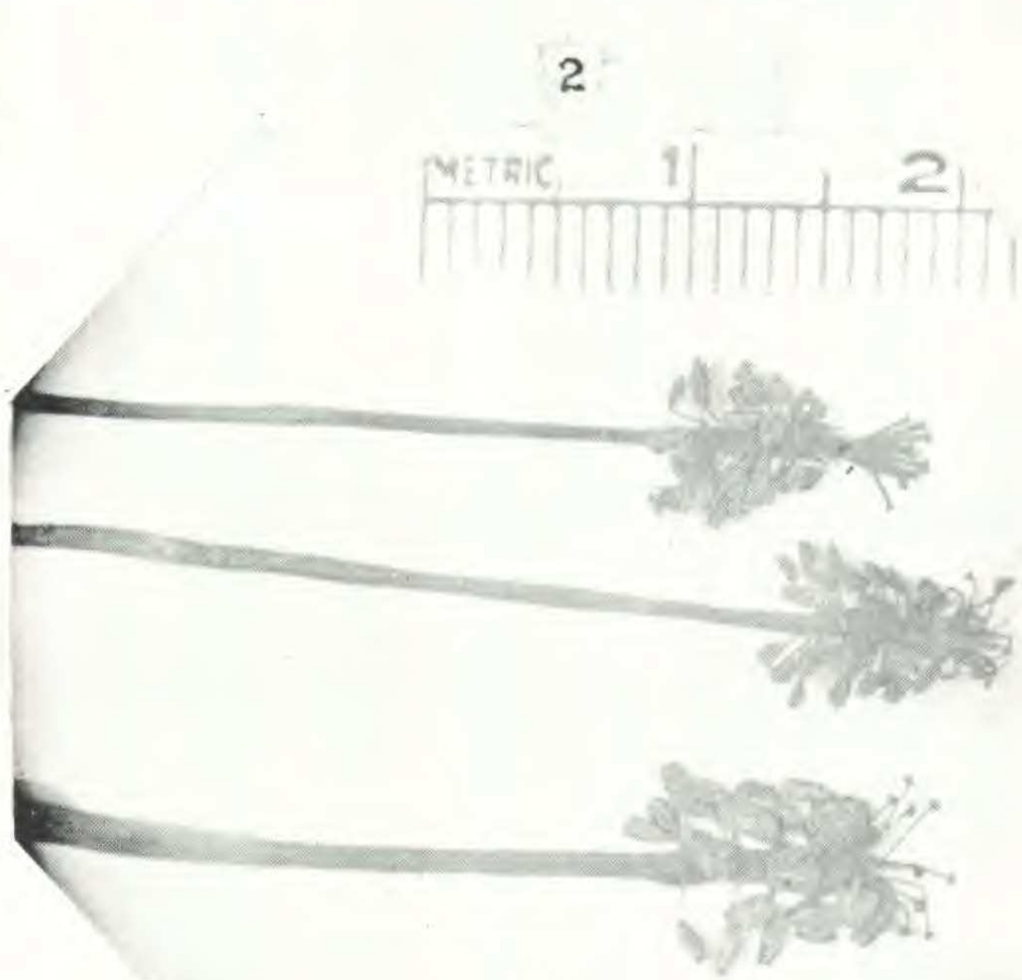

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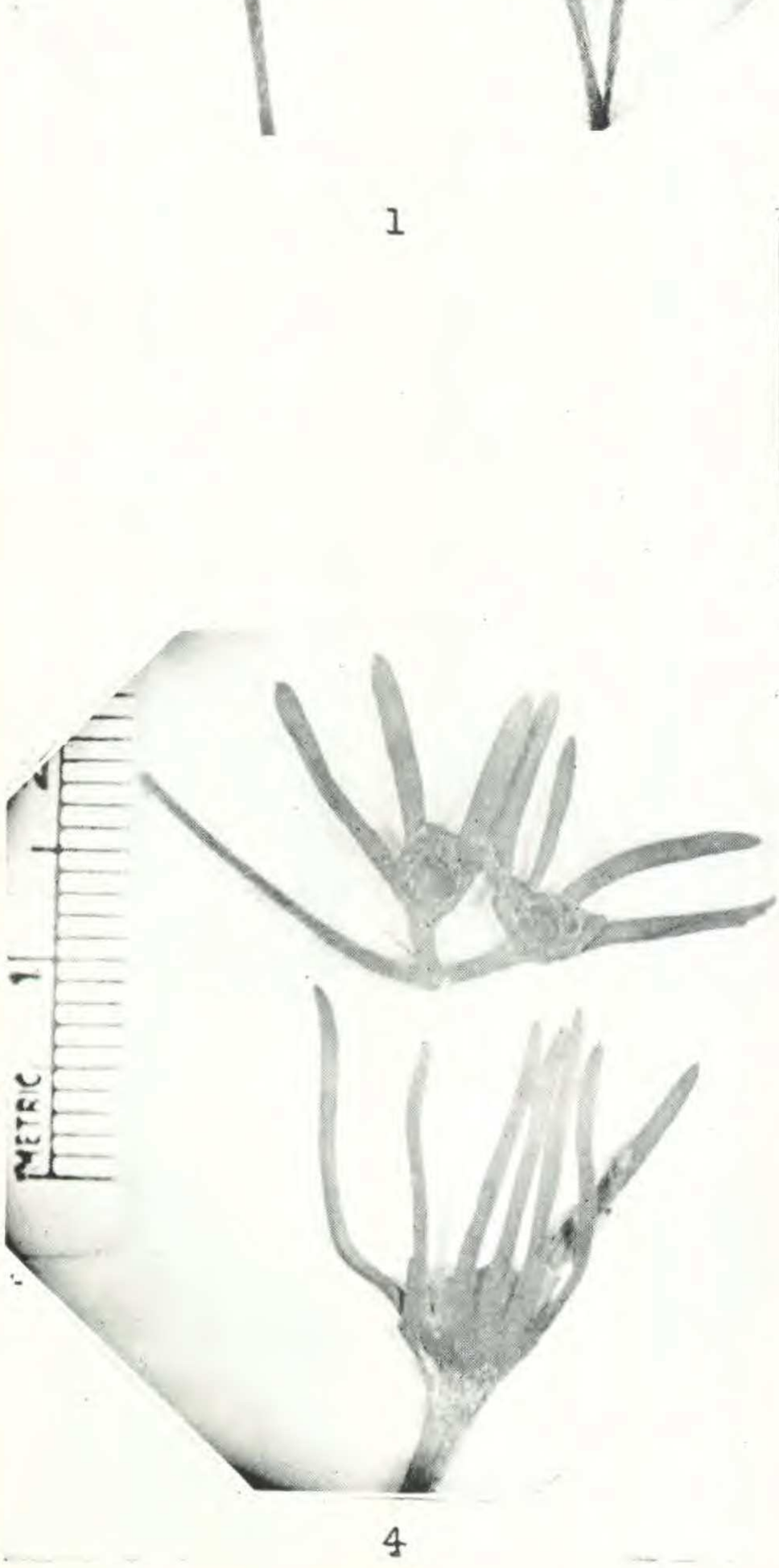

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